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WORLD PETROLEUM

NEW YORK AND LONDON

FEBRUARY 1937

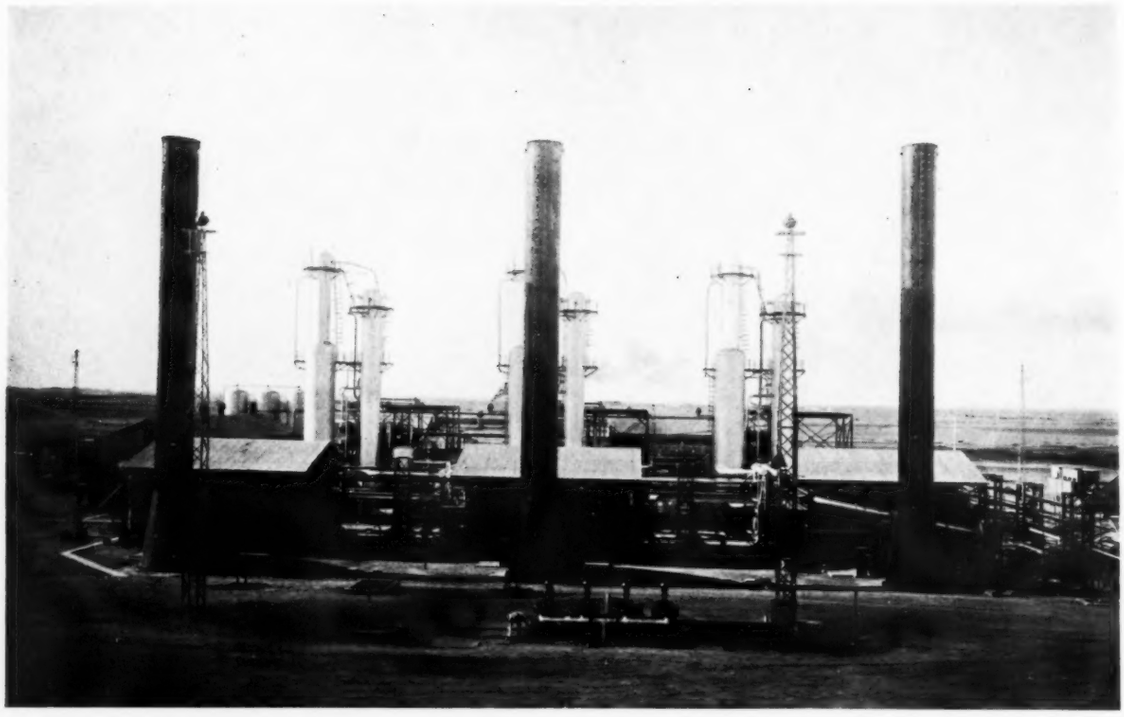
SOCONY-VACUUM, AN INTERNATIONAL LEADER

RUSSIA'S DECREASING EXPORTS

NEEDED IMPROVEMENTS IN DRILLING EQUIPMENT

KIRKUK STABILIZATION PLANT

© Will Connell



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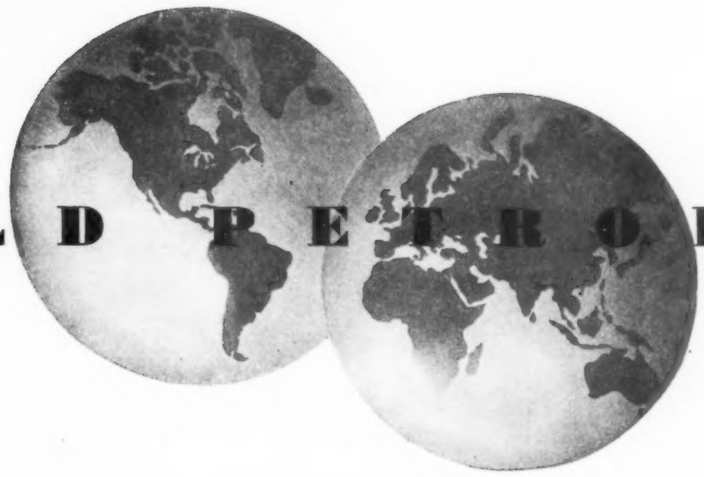

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CONTENTS

Socony-Vacuum, An International Leader . . . 34

Socony-Vacuum Tanker Fleet 50

Russia's Decreasing Importance as an Exporter 57

Needed Improvements in Rotary Equipment . . 62

Stabilization Plant at Kirkuk 67

British Imports Reach New Record 73

Washington Considers Oil Legislation 74

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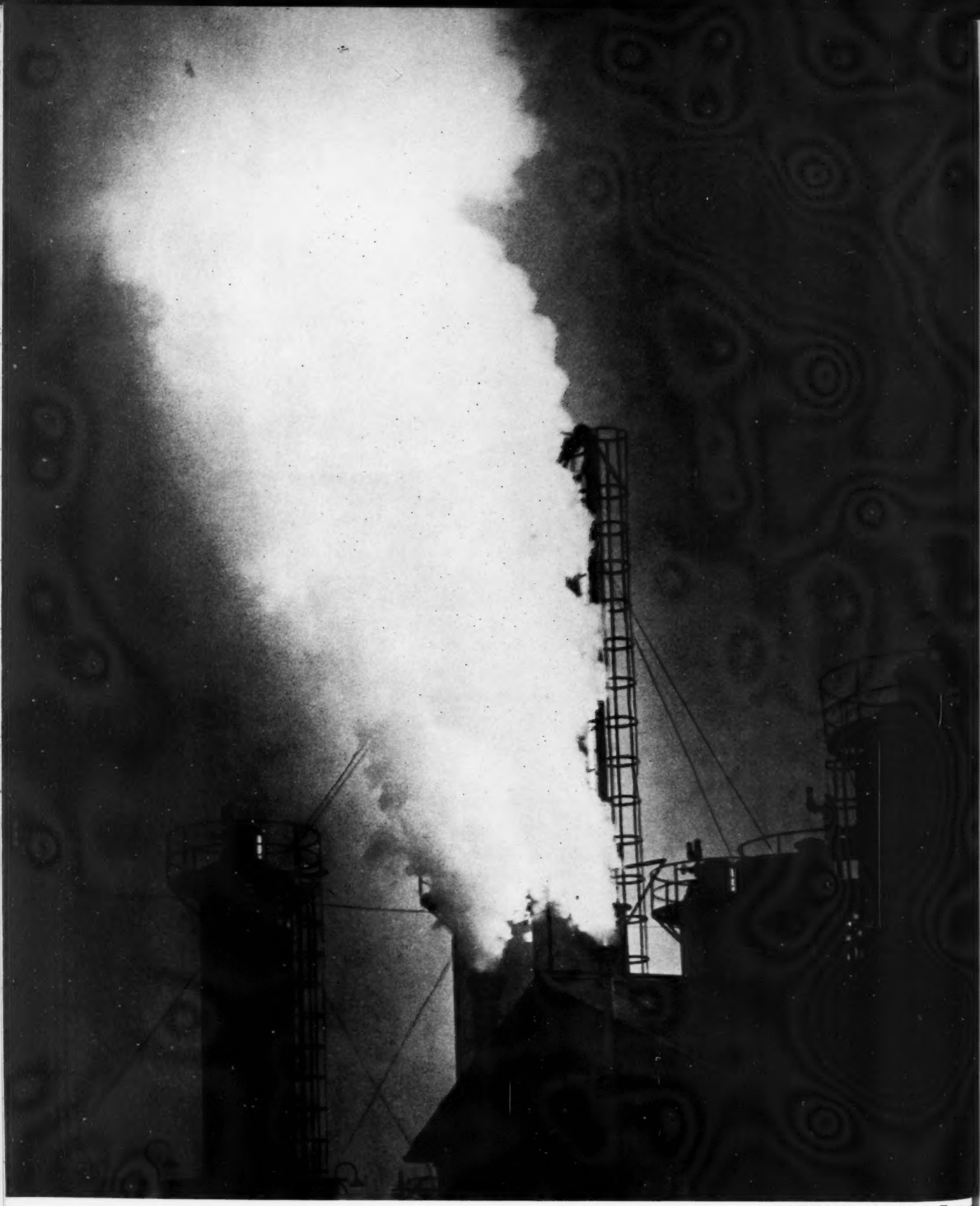


"STEAM", by S. C. Eastm

EDITORIAL

JUDGE'S ROBES FOR PUNCHINELLO

COMPLAINT is frequently made that in the political life of the United States there no longer are any great issues. President Roosevelt, however, has presented to the country a really great issue. His proposal to repeal decisions rendered by the Supreme Court of the nation against laws passed at his behest by obtaining from Congress authority to appoint additional justices in sufficient number to sway the balance of judicial opinion to conformity with his views is the most open and audacious attempt to change the fundamental structure of the country's government that has been made since Fort Sumter was fired upon.

In the presentation of this plan to the representatives of the press, and through them to the country, scarcely an effort was made to obscure this objective. The broad appointive power which the President proposes to exercise whenever judges of the higher courts who have reached the age of seventy decline to act upon hints that their resignations are in order suggests clearly enough the manner in which it would be exercised. Congress actually, though not nominally, has surrendered its functions to the Chief Executive. If now the judiciary is handed over to his control the way will be prepared for the abandonment of real constitutional government and the substitution of an effective though unavowed dictatorship.

In the earlier days of the Republic the proposal put forth by the President would have provided the setting for a great historical debate. It may do so today. While Congress trembles at sound of the most powerful radio voice in America its authority has not been signed away irrevocably. It can be reclaimed whenever the members of the national legislature display the determination to retrieve it.

Immediate reaction to the recommendation has been of a sort to demand serious consideration even from those Congressmen who ordinarily let the White House do their thinking for them. Protests have poured in, not only from leaders of the bar, of business and of public education but from tens of thousands of inconspicuous, everyday citizens who do not want their government changed to an autarchy. It is significant that the great Democratic state of Texas has called upon its representatives to stand together in opposition to the project. Where Texas leads others may follow. There still are a few men in the Senate who have the ability, if sufficiently in earnest, to rouse the country on this issue.

THE matter is not one beyond the proper sphere of a journal devoted to petroleum. It is of primary significance to every American citizen. It is of special importance to those engaged in industry. It means as much to men occupied in the production and distribution of oil and its products as to those in any other pursuit—perhaps more than in the case of some others.

The reason for this is not far to seek. Subjection of the judicial to the executive power is not sought merely to gratify a personal whim. It is to pave the way for the imposition of schemes of federal control over trade and industry that the offending judges have pronounced unconstitutional and un-American. It is to make possible the establishment of a politico-social-economic theory that is the extreme opposite to that freedom of action, individual initiative and personal liberty that have been so jealously safeguarded in America in the past.

Before the echoes of the President's first statement had ceased to reverberate along Pennsylvania Avenue, before Congressmen had had opportunity to read the bill that was handed to them ready-made to effect the President's wishes, a group of men behind the Washington scene who had remained strangely, unnaturally silent throughout last year's Presidential campaign sprang into action. It was announced that the NRA, the AAA and other exotic flowers of governmental control dating back to the hectic days of 1933 and 1934 were to bloom again. The assumption behind these proposals apparently was that before such legislation could come up for final judicial review the Supreme Court would have been so reconstituted as to present no obstacle to its acceptance as the law of the land.

Members of the oil industry have been inclined to be impatient of restraints even in some cases where these were imposed for their own good. They have fought for the right of free, open and fair competition. If they hope to preserve that right they cannot afford to take a neutral stand in the contest now being staged in Washington.

SOCONY-VACUU

FROM a room overlooking one of the world's great ports Socony-Vacuum's executive committee of five directs a business extending to every quarter of the globe. The company is actively engaged in all three divisions of the petroleum industry—production, refining and marketing—and into the headquarters at 26 Broadway come current reports on these activities, both here and abroad. While, pursuant to Socony-Vacuum's policy, the affiliated companies exercise a considerable amount of independent authority, the responsibility for the direction of the organization as a whole lodges finally in these five men: from left to right—Harold F. Sheets, Vice President; George V. Holton, General Counsel; John A. Brown, President; Frederick S. Fales, Vice President; Arthur F. Corwin, Vice President.

Leader in the International Field

Activities Span Oil Industry and Extend to All Quarters of the Globe. Principally a Marketer in the Beginning, the Company Has Advanced Toward Complete Integration

Out of a grocer's backyard in Rochester, New York, and a small refining plant in Brooklyn, has grown an organization that holds its place as one of the four petroleum corporations that may properly be described as world-embracing in the scope of their operations. The history of this company is unusual. Its two principal components were once members of the same family until 1911; then for a score of years they followed separate paths and grew to many times their original size; and finally they were brought together again in 1931 to form the Socony-Vacuum Corporation (now Socony-Vacuum Oil Company, Inc.).

It was logical that this merger should be sustained by the courts because the two companies, while each holding high rank in the oil industry, had developed along lines so distinctly separate that their activities were clearly complementary rather than competitive. That fact likewise explains the strength of the combined organization and the important position it at once assumed among the leaders in the international oil field.

Through one branch of its family tree, Socony-Vacuum is one of the industry's pioneers. The Vacuum Oil Company was organized in 1866, only seven years after Colonel E. L. Drake drilled his history-making well on Oil Creek in Western Pennsylvania. At that time the Standard Oil Company was not yet in existence, and John D. Rockefeller was just beginning to get a foothold in the refining business.

The Vacuum Company was the outcome of some crude experiments in distillation carried on by Hiram B. Everest who conducted a small grocer's shop in Rochester. A friend of his, Matthew P. Ewing, a local carpenter, had evolved the theory that by heating crude oil under vacuum, the recovery of kerosene—then its one valuable constituent—would be greatly increased. Experiment did not sustain the theory, but Everest saw in the residue from the still, which came through without being burned, possibilities as a lubricant.

The Vacuum Oil Company was organized primarily for the production of lubricants and other oils for industrial uses, but it was a matter of some difficulty to convince the operators of machinery that a mineral oil could serve as well as fat and tallow in the lubrication of their equipment. Sales of the new product increased but slowly for the first few years. Ewing became discouraged and sold out his interest, but Everest retained his confidence in the superiority of his product and remained at the head of the company until 1900, long after it had become an important unit in the Standard Oil organization.

By 1879 the company had reached a position of importance that led John D. Rockefeller to include it as a member of the group he was organizing to cover all phases of petroleum refining, transportation and marketing. In this new relationship Vacuum continued to specialize in the manufacture of all classes of lubricant. Its products were sold in the United States largely through the various Standard Oil marketing organizations, and its supplies likewise were purchased from other members of the group. Abroad, Vacuum marketed principally under its own name. The company was under no necessity of developing crude production or finding new marketing outlets. Its activities were concentrated upon manufacture and upon research to improve the quality and variety of its products.

Socony's Beginning

With the growth of the business of the Standard Oil organization, a new subsidiary, to which was given the corporate name of Standard Oil Company of New York, was formed in 1882. To it was assigned the development of export business as well as the sale of petroleum products in New York and New England. Although legally an offshoot of the Standard Oil Company of Ohio, in a sense Standard of New York was the lineal successor to a still earlier enterprise founded by Charles Pratt & Company in Brooklyn, New York.

The Pratt family had entered the refining industry in the early seventies and had developed an important business by the time Standard Oil of Ohio was ready to expand to the Atlantic Seaboard. The two interests were combined, and Charles Pratt became a leading figure in the later expansion of Standard's activities. His son, Herbert L. Pratt, later on was the chairman of the board of Socony-Vacuum. In the United States the marketing activities of Standard Oil Company of New York were confined mainly to the six New England states and to New York. So extensive were its marketing activities in this territory that the New England and New York area was aptly described by the term "Soconyland" which the company applied to it later on in advertising.

At the same time the company exercised a free hand in building its business abroad, particularly in the Orient where the symbols borne by its cans presently came to be as well known as they were in northeastern United States.

By reason of its vast population and the total absence of modern means of illumination, China offered alluring possibilities as a market for kerosene. The obstacle was the lack of lamps suitable for its use. By devising lamps that could be sold for a few cents each, the company overcame this difficulty and created a tremendous demand for its product. This was one of many measures employed to build up confidence and consumer support in the Orient, whereby the company established itself in a position of strength which it has been able to hold down to the present day.

Thus, as friendly, but independently oper-

While a refining process marked the beginning of Socony-Vacuum at Rochester, this first Vacuum Oil Co. well completed in 1879 at nearby LeRoy, N. Y. was the first step in building an integrated *company.*

SOCONY-VACUUM OIL COMPANY, INC.

26 Broadway, New York City

Principal divisions, affiliates and branches

DIVISIONS OPERATING IN THE UNITED STATES

Standard Oil of New York —
serving New York and New England.

Philadelphia Division —
serving Pennsylvania, New Jersey and Delaware.

White Star Division —
serving Michigan and Ohio.

Chicago Division —
serving Chicago and vicinity.

Wadhams Oil Company —
serving Wisconsin.

Lubrite Division —
serving Eastern Missouri and parts of Illinois, Indiana and Iowa.

White Eagle Division —
serving the Middle West and Northwest States east of the Rocky Mountains.

Southeastern Division —
serving Maryland, Virginia, West Virginia, District of Columbia, North and South Carolina.

Magnolia Petroleum Company —
serving Texas, Oklahoma and adjacent states.

General Petroleum Corporation of California —
serving the Pacific Coast states and adjacent territory.

LATIN-AMERICA

Vacuum Oil Company de Mexico S. A.

Compañia Socony-Vacuum Oil Co. de Colombia

Socony-Vacuum Oil Company C. A. (Venezuela)

South American Gulf Oil Company —
Owned jointly with The Texas Corporation.
(This South American company owns 80% of the stock of Colombian Petroleum Co., and the two companies own the Barco concession in Colombia).

Ultramar S. A. Petrolera Argentina —
Owned jointly with The Texas Corporation.

EUROPE

Vacuum Oil Company, Limited (England)
Vacuum Oil Company S. A. F. (France)
Deutsche Vacuum Oel A. G. (Germany)
Vacuum Oil Company S. A. I. (Italy)
Vacuum Oil Company A. S. (Czechoslovakia)
Vacuum Oil Company A. G. (Austria)
Vacuum Oil Company R. T. (Hungary)
O/Y Vacuum Oil Company A/B (Finland)
"Photogen" Rafinerie de Petrol S. A. (Roumania)
Vacuum Oil Company Limited (Ireland)
Vacuum Oil Company S. A. (Poland)
Vacuum Oil Company S. A. d.R. (Roumania)
Standard-Vacuum Oil Company of Jugoslavia, Inc.
Vacuum Oil Company A. B. (Sweden)
Norsk Vacuum Oil Company A. S. (Norway)
Vacuum Olie Maatschappij N. V. (Holland)
Vacuum Oil Company S. A. B. (Belgium)
Vacuum Oil Company S. A. E. (Spain)
Vacuum Oil Company of Canary Islands S. A. E.
Vacuum Oil Company A. S. (Denmark)
Gibraltar Vacuum Oil Company Limited
Compagnie Industrielle des Petroles (France)

FAR EAST

Standard-Vacuum Oil Company —
Owned jointly with Standard Oil Company (New Jersey). Operates in Japan, North and South China, Straits Settlements, India, Australasia, South and East Africa, and Sumatra.

ASIA, ASIA MINOR, NORTH AND WEST AFRICA

Socony-Vacuum Oil Company, Inc., Levant Division (head office — Istambul).

Socony-Vacuum Oil Company, Inc., Near East Division (head office — Cairo).

Near East Development Co. (Iraq) —
Owned jointly with Standard Oil Company (New Jersey), holding 23¾ per cent interest in Iraq Petroleum Co., Ltd.

Vacuum Oil Co. (Del.) — Portugal and West Africa.

THE CELEBRATED
UUM OIL BLACKING
TS HARNESS PERFECTLY
AUGUST 12TH 1874 AT ROCHESTER, N.Y. 2.14¾
GOLDSMITH MAID.
SEPT. 2ND 1874 AT MYSTIC PARK 2.14
Published by Vacuum Oil Co. Rochester N.Y.

Goldsmith Maid establishing a record of 2.14¾ for the mile at Rochester in 1874—while Vacuum promotes the sale of one of its many specialties in the background. The entire scene was reproduced as a poster and adorned many a livery stable and harness stop in the days when harness racing was America's leading sport.

ated members of the same family group, Vacuum and Socony developed along parallel, but largely unrelated lines.

Effect of Standard's Dissolution

In 1911 a court decree ordained the dissolution of the Standard Oil group. The dissolution order left the component companies standing alone and facing the necessity of making their own way in a highly competitive world. The unscrambling of the parent organization found the Vacuum Oil Company and Standard Oil of New York in positions strikingly similar. Both had important assets, including valuable items of good will, but neither was a fully integrated company and by reason of this fact they faced serious problems.

Vacuum emerged from the dissolution with brands and trade marks which, because of its previous attention to research and advertising, were the most valuable in the entire oil business. It received also the refineries in Rochester and Olean which it had operated for many years, and a small compounding plant. Besides these it had extensive marketing organizations for light products and lubricants abroad.

Standard Oil of New York had its established position in New York and New England and its profitable outlets in the Orient and the Near East. Of tangible assets it received three refineries, two on the New York waterfront and one in Buffalo, New York. These were unable to fill the marketing requirements of the company even then and were inadequate as equipment for a company that was engaged in an international business. In 1911 neither company had in its control a single barrel of crude production.

Lack of a crude supply was not such a severe handicap to Vacuum because its products were made from a limited volume of selected crudes which had to be drawn from various fields. Standard of New York, on the other hand, had an important marketing position to defend. It had developed a vast export business in kerosene, and it faced a swiftly growing demand for gasoline. These demands required a heavy volume of crude which had to be purchased from companies which were now its competitors. Moreover, its refining equipment was altogether inadequate, and it lacked storage plants and bulk distributing stations.

Building operations were immediately undertaken. Refineries were enlarged, and a new one was erected at Providence, Rhode Island. Bulk storage plants and warehouses were sprinkled throughout its marketing territory. This form of expansion, however, could not keep pace with the swift growth of demand. At the same time the lack of an assured crude supply remained a menace to the stability of the company's business structure.

For the prompt solution of its problems the company adopted the only practicable course by acquiring ownership of other companies already equipped with producing and refining facilities. The first move was to purchase a controlling interest and later complete ownership of Magnolia Petroleum Company in Texas. Magnolia held extensive producing and refining properties in the Texas field and was the oldest oil company in the state, being a direct successor of the J. S. Cullinan Company, which built the first Texas refinery at Corsicana in 1897.

A second step was the acquisition of General Petroleum Corporation, operating on the

1910—Distribution of petroleum products by the horses that petroleum largely displaced 20 years later.

Pacific Coast. The addition of these properties strengthened Socony's crude supply while General's refineries provided a well located source of white products for shipment to the Far East. Subsequently, Standard of New York purchased the White Eagle Oil Company of Kansas. To meet the need for additional supplies of lubricants, the company bought the Franklin Railway Oil Corporation of Pennsylvania, which operated a plant for the refining of lubricating oil. As each of these companies was an extensive marketer in its own territory, these purchases greatly extended Socony's sales area,

Vacuum Oil Co. S.A.F.'s building in Paris, center of French distribution of Socony-Vacuum products at 46 rue de Courcelles.

which previously had been confined to New England and New York.

While this expansion of Standard of New York was going on, Vacuum steadily enlarged its own operations, and in 1928 it added to its own marketing facilities through purchase of the White Star Refining Company of Michigan, Wadhams Oil Company operating in Wisconsin and Lubrite Refining Corporation, which supplied a growing section of the middle west from its refinery in St. Louis. Other smaller companies were taken over, giving Vacuum additional outlets in New York, Pennsylvania and Ohio. By 1929 Vacuum was operating marketing facilities in eleven states.

Consolidation of the Two Companies

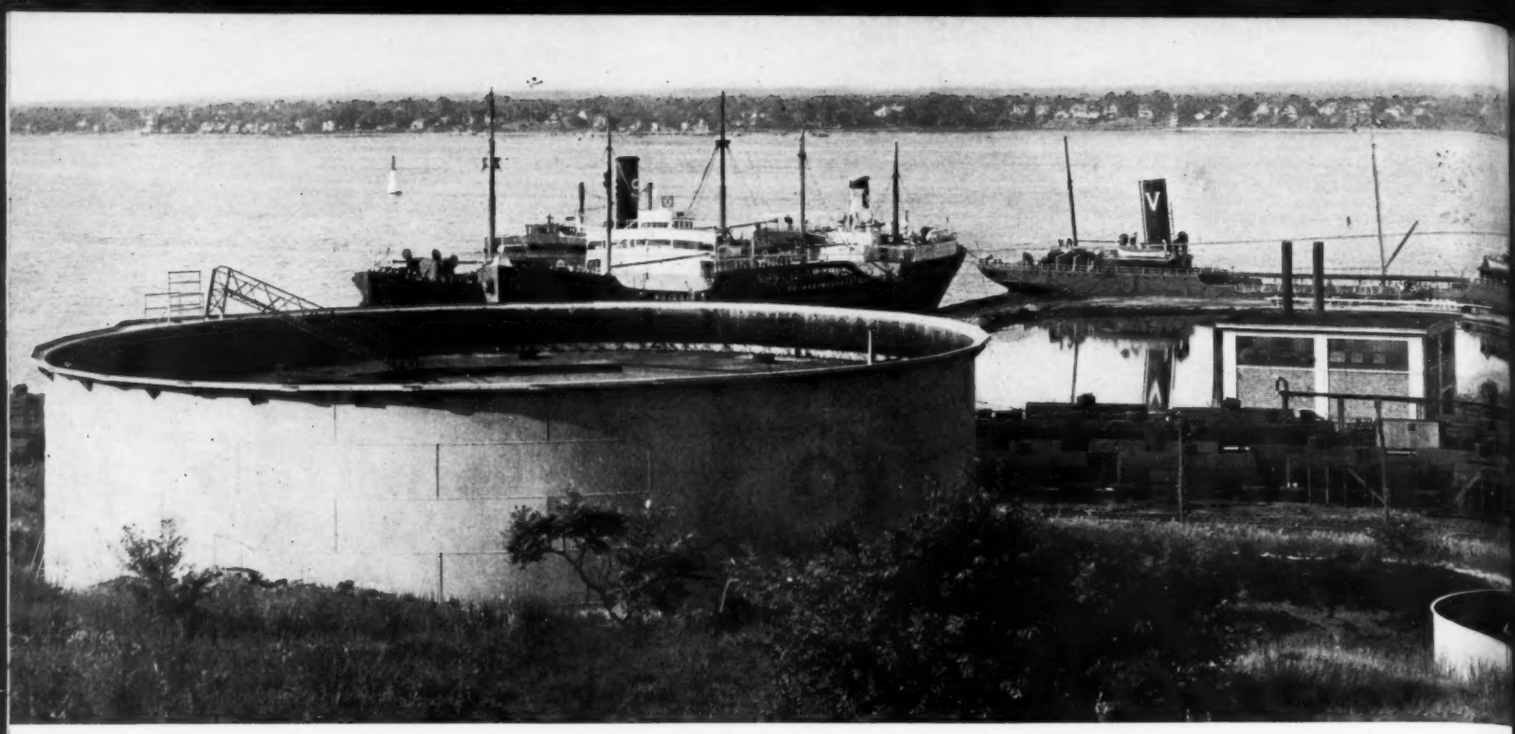
While Vacuum had departed from its original line to the extent of selling its special brand of gasoline in a section of the United States, it had remained chiefly a manufacturer and purveyor of lubricants. The bulk of its business was abroad. The greater part of the business of Standard of New York was in the United States. Both companies planned to extend their operations to cover the American field, but had taken only partial steps toward the realization of this ambition. Consequently, the Vacuum Oil Company and Standard Oil of New York were combined in 1931 in the Socony-Vacuum Corporation. The new company took its

26 Broadway, world's most famous business address—the company's administrative center directing the production, manufacture and distribution of petroleum products throughout the world.

place alongside Standard Oil of New Jersey and the Royal Dutch-Shell group as one of the triumvirate of oil companies whose operations extend to every part of the world.

John A. Brown, who had been President of General Petroleum Corporation of California since 1930, subsequently became chief executive officer of Socony-Vacuum and was given the title of President and Chairman of the Executive Committee in 1935. Mr. Brown has been in the oil industry for 25 years. He has had extensive practical experience in oil drilling and oil production, both in this country and abroad. In 1911 he went to California as secretary-treasurer of a small oil producing company, and from 1919 to 1926 he was in charge of the Mexican business of Standard Oil Company (New Jersey). He then went to the Dutch East Indies in charge of the company's operations there and returned to the United States in 1928 and became Vice President, and later President, of the General Petroleum Corporation of

From Magnolia's refinery at Beaumont, Texas, to Trafalgar Square, London—Socony-Vacuum's products have traveled to foreign markets in an almost continuous stream for many years, regardless of national crises, market conditions or other contingencies, that frequently cut off the supplies from less responsible firms.



Fuel oil and gasoline from Texas and California pass through these Providence, R. I., loading facilities to the trucks and factories of New England's industries.

California. His experience and ability combined to qualify him to take a leading position in the petroleum industry.

Having at its command the services of men who had been identified with the building of two great companies, Socony-Vacuum has been able to form an executive group of exceptional ability. In addition to Mr. Brown, the members of the Executive Committee are Arthur F. Corwin, Vice President; Frederick S. Fales, Vice President; Harold F. Sheets, Vice President; and George V. Holton, General Counsel. The Board of Directors is a so-called "management" board, principally composed of officers of the company.

Production

Through its control of Magnolia Oil Company and General Petroleum Company, Socony-Vacuum has become an important producer of crude oil. It is noteworthy, however, that the company produces less than half its total consumption and remains one of the largest purchasers of crude both for domestic and foreign requirements. In this respect it has followed a policy inherited both from Vacuum and Standard of New York. It has not developed its producing properties to their full capacity, but has preferred to make purchases from other producers in an effort to contribute to the stability of this branch of the industry. At present it is moving in the direction of producing more of its own crude requirements.

Most of the developed production of Socony-Vacuum comes from the fields of Magnolia Petroleum Company in Texas, Oklahoma and Louisiana, and from those of the General Petroleum Corporation in California. A great part of the remainder of the company's crude supply for its domestic refineries is purchased in the fields in which these two subsidiaries operate, and is carried through their pipeline systems. In 1935 the company had 7,374 producing oil or gas wells in the United States, and its gross production of crude oil within the country averaged 121,403 bbl. a day. Land and leases in the United States owned by the company for future oil and gas development totalled 4,392,997 acres.

Socony-Vacuum has been a consistent supporter of the policy of oil conservation. In Texas, the Magnolia company has labored steadily to establish stable conditions in the troublesome East Texas field, and in California, General Petroleum has been one of the active factors in the organization of the Kettleman North Dome Association.

The company's crude oil production outside the United States is mostly in companies in which part interests are owned. Socony-Vacuum has an 11⅞ percent share interest in the Iraq Petroleum Company, which in 1935 moved an average of some 74,000 bbl. a day to Mediterranean ports. Standard-Vacuum Oil Company, in which Socony-Vacuum has a 50 percent interest, produced an average of 38,000 bbl. crude oil daily in Netherland India in the same year.

The company has been aggressively pursuing its policy of strengthening its reserves in recent months. Early in 1936, Socony-Vacuum and The Texas Corporation purchased the principal interest in the famous Barco concession, representing the oil rights to about 500,000 acres in Northeastern Colombia. It will be two or three years before this area is in production. At about the same time the company added to its acreage in the Rodessa oil field in Louisiana and Texas; and a little later obtained the exploitation rights over some 741,000 acres in Venezuela.

Petroleum against a background of ancient civilization in Egypt.

For the delivery of its products to their markets the company has a vast transportation system, including pipelines totalling 7,800 miles; a land fleet of 2,300 tank cars and 6,200 motor vehicles; a marine fleet of over 200 vessels.

The pipelines are used chiefly for transportation of crude from producing fields to the company's refineries, but they include also several lines employed in the transportation of gasoline.

Its water fleet includes tankers, motor barges, river steamers, tugs and lighters; and a variety of domestic and foreign small craft—launches, junks, sampans—not included in the above-mentioned total. Incidentally, one of the methods by which the old Standard of New York established its firm hold upon the Chinese market was the operation of shallow draught steamers on the Yangtsekiang River. These steamers carried the company's flag and cargoes of kerosene to native communities scattered along 500 miles of the river's winding course.

Refining

Socony-Vacuum has 17 refineries and 20 natural gasoline plants strategically located with reference to important American markets. Their daily capacity on December 31, 1935, was about 267,500 bbl. The company also has 11 refineries in Europe.

Practically everything that can be made from petroleum is manufactured in one or another of Socony-Vacuum plants. The company's products include several hundred different lubricants and fuels for industry, marine service, aviation and the farm, in addition to a line of specialties, such as asphalt for roads, range oil, cleaning fluids, furniture polish, floor wax, disinfectants and candles.

World-Wide Marketing

Within the United States Socony-Vacuum sells lubricants in practically every state, and gasoline in some 35. The company's subsidiaries have now been changed into ten marketing divisions, but where the subsidiary names were well known locally, marketing activities are conducted under those names. Thus, Magnolia Petroleum Company directs sales in the southwest, and General Petroleum along the Pacific Coast. Similarly, the good will attaching to former subsidiaries such as White Eagle in the territory between Mississippi and the Rocky Mountains, White Star in Michigan, and Lubrite in Missouri, Illinois and Indiana, is maintained by applying these names to the divisions operating in those areas.

At the same time, while the local good will of these names is retained, the uniform quality of the product is indicated by the company's symbol of the Flying Red Horse. Indeed, this symbol was used to indicate not only quality of product, but quality of service. The company was one of the first to realize the importance of the service station as a direct contact with the public. It set about improving the manners, appearance and efficiency of its thousands of service stations in the United States, until today the American service station has become world-famous. In the past two years, in common with other oil companies, Socony-Vacuum has been leasing its service stations to independent operators.

With the principal exception of Russia, the company's products are marketed in practically every country in the world. This trade falls under two general classifications:

(1) The area served by the Standard-Vacuum Oil Company, including Japan, North and South China, Straits Settlements, India, Australasia, South and East Africa and the producing-refining properties in Sumatra known as Koloniale.

(The Standard-Vacuum was formed on October 1, 1933, owned half by Socony-Vacuum and half by Standard Oil (New Jersey) in order to make possible numerous economies in the Oriental trade through the joint use of refineries and sales organizations in connection with production in the same region.)

(2) All other markets outside the United States, including Europe, Africa, South and Central America.

For its foreign trade the company buys a certain amount of its supplies from Russia, Roumania, Venezuela and Colombia. The balance of its purchases comes largely from the United States, and the company has, of course, its production from Iraq.

To conduct sales operations successfully in many different countries calls for a high degree of organizing and selling ability in order to meet differing trade customs and conditions. Socony-Vacuum has endeavored to meet this problem by identifying itself closely with the people among whom it conducts business. In all the widely separated countries in which the company operates, its organizations are distinctively local and to a great extent are manned by natives of the particular country in which they are located. The company has not regarded its foreign trade merely as an effort to sell exports abroad, but also as an effort to establish in foreign countries, wherever possible, largely independent corporate units subject to the laws of those countries and contributing to their economic development.

The conduct of export trade has been beset by difficulties ever since the outbreak of nationalism after the world war. Petroleum did not escape the clutter of restrictions and requirements that have been thrown upon international commerce. Indeed, because of its military importance petroleum has been the particular concern of many governments. In a desperate effort to free themselves from dependence upon oil from other nations, several countries in Europe and Asia have pursued one or more of the following three methods:

(1) By tariff or other regulations they have made it necessary for companies operating within their borders to build local refineries.
(2) They have tried to impose upon private companies storage requirements in excess of the supply needed for commercial purposes.
(3) They have promoted the development of substitutes for gasoline.

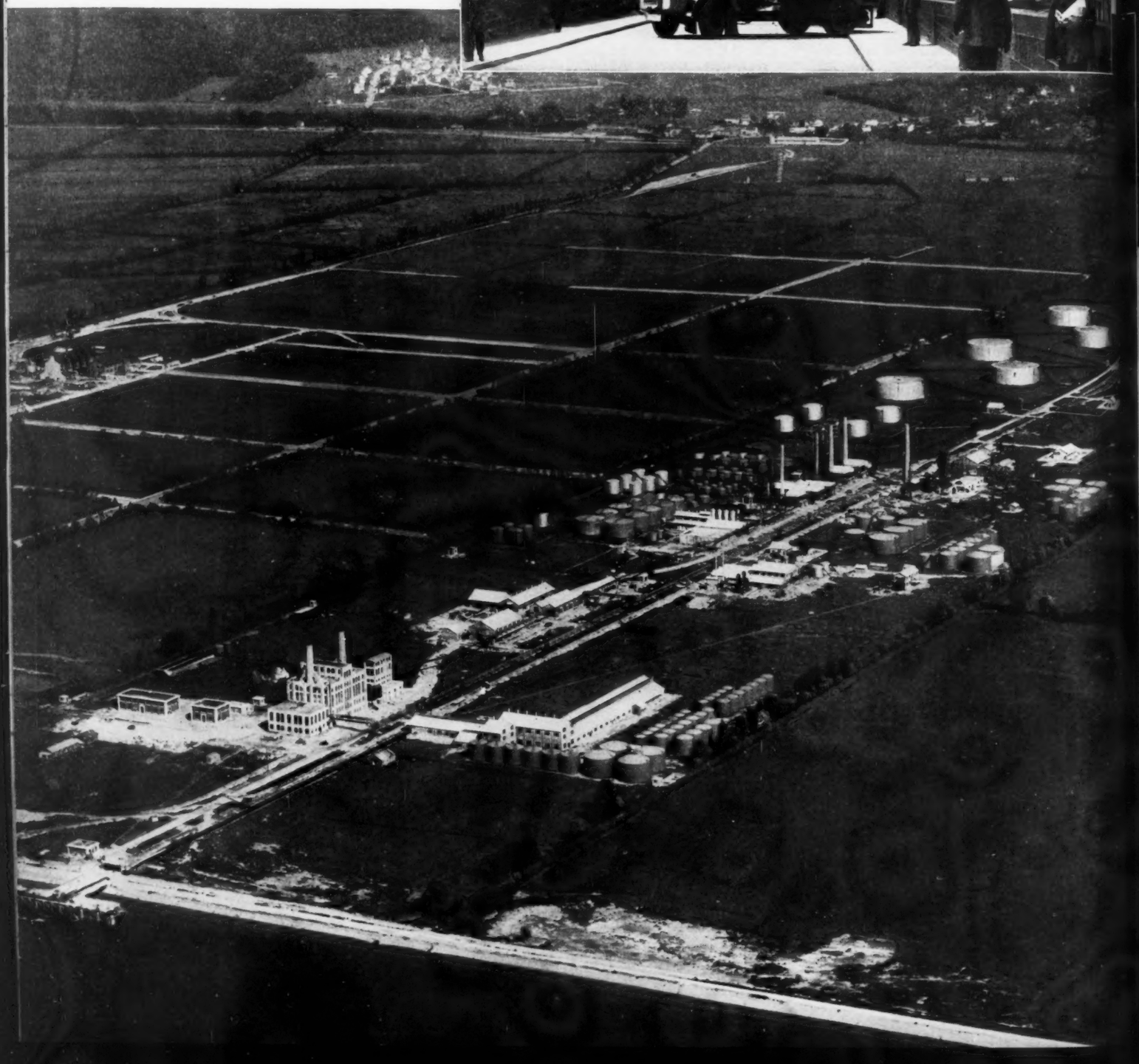
To date, these methods have served very little purpose except to increase the cost of

In the search for oil, General Petroleum, California subsidiary of Socony-Vacuum, penetrated the earth's surface 12,000 ft. Only oil companies with extensive resources can afford the test drilling necessary for tomorrow's oil.

oil and its products to the consumer and to make it a little more difficult for the oil companies to supply the normal foreign demand. The cost of gasoline in the United States despite the high federal, state and local taxes is, of course, very much lower than it is anywhere in Europe.

Research

One of the distinguishing features of the company throughout its history has been the great amount of attention it has devoted to research. In the early days of the industry, there was only one kind of lubricating oil for all purposes. No purchaser thought of asking for a particular kind or brand when buying, and no seller was in a position to suggest that any distinction might exist. In order to develop lubricants that would be especially adapted to different classes of machinery, the company engineers

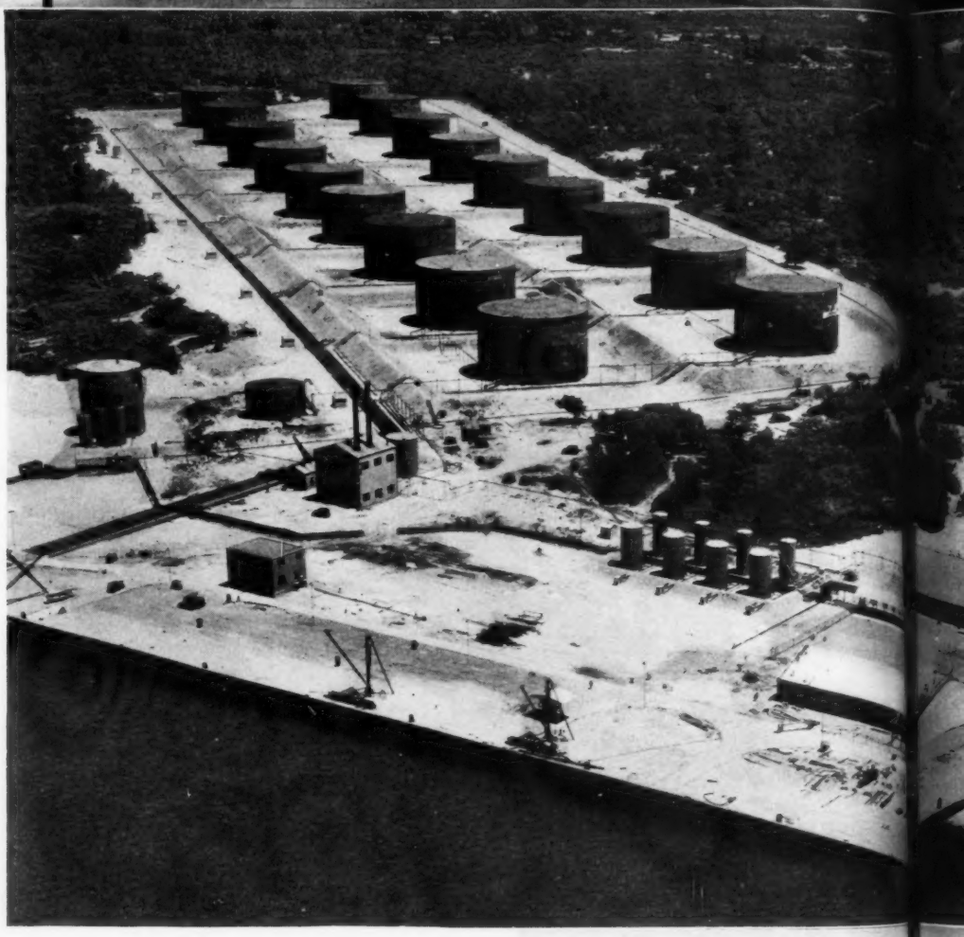


Modern Socony-Vacuum tank truck before the historic gates of Prague, Czechoslovakia, shown in the upper left hand picture, while directly below is the great Gravenchon refinery in France built in conformity with the oil policy of the French government.

←

Oil originating in Texas is refined in the modern plant at Paulsboro, shown above, and the products sold in stations like the Austrian outlet pictured below.

A familiar sight to New England motorists: stations designed to blend with the architecture and traditions of this section.



experimented with all sorts of equipment, both in collaboration with the equipment manufacturers and on their own account.

When motor cars came into general use, Socony-Vacuum was among the first to advertise to motorists the fact that different conditions of weather and temperature, and different types of engines required different lubricants. By long and careful experiment, its "chart of recommendations" was worked out as a guide to motor vehicle operators.

The members of the company's technical staff proceeded on the assumption that they should be prepared to solve every lubrication problem, wherever it developed, and to supply to users of machinery, whether in the United States or in the most remote land, really expert advice and assistance. The result was not only to demonstrate the value of such research, but also to make Mobiloil, Gargoyle, and other of the company's brand names familiar words in every language.

Socony-Vacuum carries on its research principally in its well-equipped laboratories in Paulsboro, N. J. and Brooklyn, N. Y. Within recent years much important work has been done in de-waxing lubricating oils; and Socony-Vacuum was among the first users of the centrifugal de-waxing process and operated the first commercial contact filtration plant for refining lubricating oils. Research conducted by the company has led to the use of improved de-waxing methods by employing special solvents, and Socony-Vacuum is today probably the largest user of solvent de-waxing. It has also developed continuous acid treatment for certain lubricating oils and for gasoline, employing centrifuges in both instances to throw out the acid sludge. Socony-Vacuum installed the first two-stage atmospheric and vacuum distillation unit for handling crude oil and its products, and has, in one of its plants, the largest combination crude distillation and cracking unit of this type in existence. The result of the company's research activities has led to its widespread use of combination distillation units, with large resulting economies in fuel maintenance and labor.

Above, **SS Socony-Vacuum** *being launched in January, 1935.*

Left, Port Socony, the company's great oil terminal on Staten Island.

Another modern method of oil transportation—loading rack at the Kansas City terminal of the Augusta-Kansas City pipeline completed in the fall of 1936.

Socony-Vacuum has pioneered in the refining of lubricating oils by chemical solvents where the conventional acid treatment was found inadequate. As a result of this work the company has in operation six solvent refining plants in as many different refineries, and another is now in course of construction. By means of these new processes, it has been possible to produce automobile and aircraft engine oils of special merit.

Another phase of investigation which has received special attention from Socony-Vacuum's research engineers has been the improvement of transformer oils, and the company's products of this type are recognized as being of outstanding quality. Much work has been done in the development of pour point depressants for motor oils and in the discovery of addition agents capable of improving motor oils in certain specific directions. It is no longer regarded as sufficient to refine the best grade of crude oil in accordance with the best process; but to the finished oil may be added certain agents in order to improve any one of several characteristics such as resistance to oxidation, wear resistance, and corrosion of certain very sensitive types of engine bearings.

Research in the use of addition agents included the treatment of light distillate products, such as kerosene and gasoline. One of the favorable results of this work has been the development of a large number of inhibitors to protect gasoline against gum formation and to stabilize or restore the color. For example, some time in 1928 Socony-Vacuum discovered that hydroquinone, a chemical used almost exclusively by photographers, had the power of restoring kerosene and gasoline to its normal colorless condition in instances where these products had discolored as a result of long storage in tropical and semi-tropical countries. This discoloration does not affect the quality of the product; it merely affects its sales appeal. Engineers were sent throughout the entire foreign marketing territories, instructing local representatives of the company how to use the restoration process. This work has resulted in continuing savings over the succeeding years and has been of outstanding value to the company in its foreign operations.

Special greases to meet the needs of almost

The distinctive characteristic of Socony-Vacuum is the international scope of its operations: Above, drums of lubricating oil transported by camel in Cyrenaica, Italian Libya; left, Mobiloil in Egypt; below, Signal Hill, California, where General Petroleum is a large producer.

Another General Petroleum producing area in Santa Fe, California.

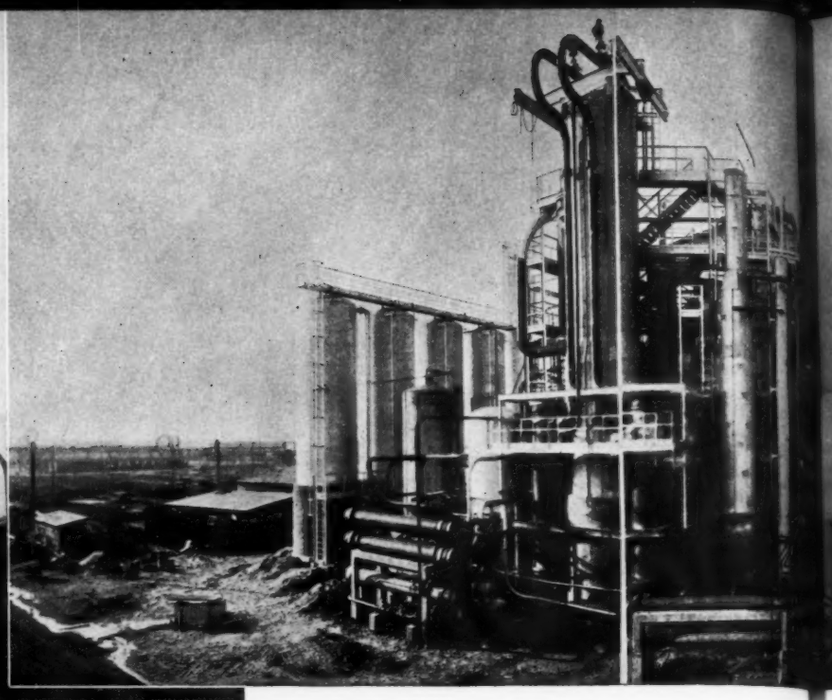
every conceivable type of service have been developed as the fruit of research, with the result that the company's standing as a manufacturer of specialized greases and lubricating products has been maintained and enhanced. For example, in 1936 the company reported the development of the following special greases, the manufacture of which had been established during the year: Low temperature grease, pneumatic tool grease, underwater gear grease, plunger grease, acid resisting grease, top roll lubricant, wheel bearing grease, twister ring grease, and drawing grease.

The company has a Refinery Processes Committee, which includes engineering representatives from all of its refineries, and which works in close cooperation with the company's research engineers. This committee has done much in improving cracking processes used by the company, particularly in the direction of the installation of combination crude distillation and cracking units, and as a result of its recommendations very marked improvements in refinery processing equipment within the company have been brought about during recent years.

Employee Relations

The employees and management in nearly all domestic operations of Socony-Vacuum have for some years successfully settled in conference the questions of wages, hours of labor and working conditions. These negotiations take place in regular joint meetings as prescribed for in the Employee Representation Plans. Those attending include representatives of the employees and certain appointed representatives of management. Any subject may be brought up in these joint meetings, and no general change involving wages or hours is

Mobiloil shop at the Jaffa gateway in Palestine.



Careful testing of products assures uniformly high quality.

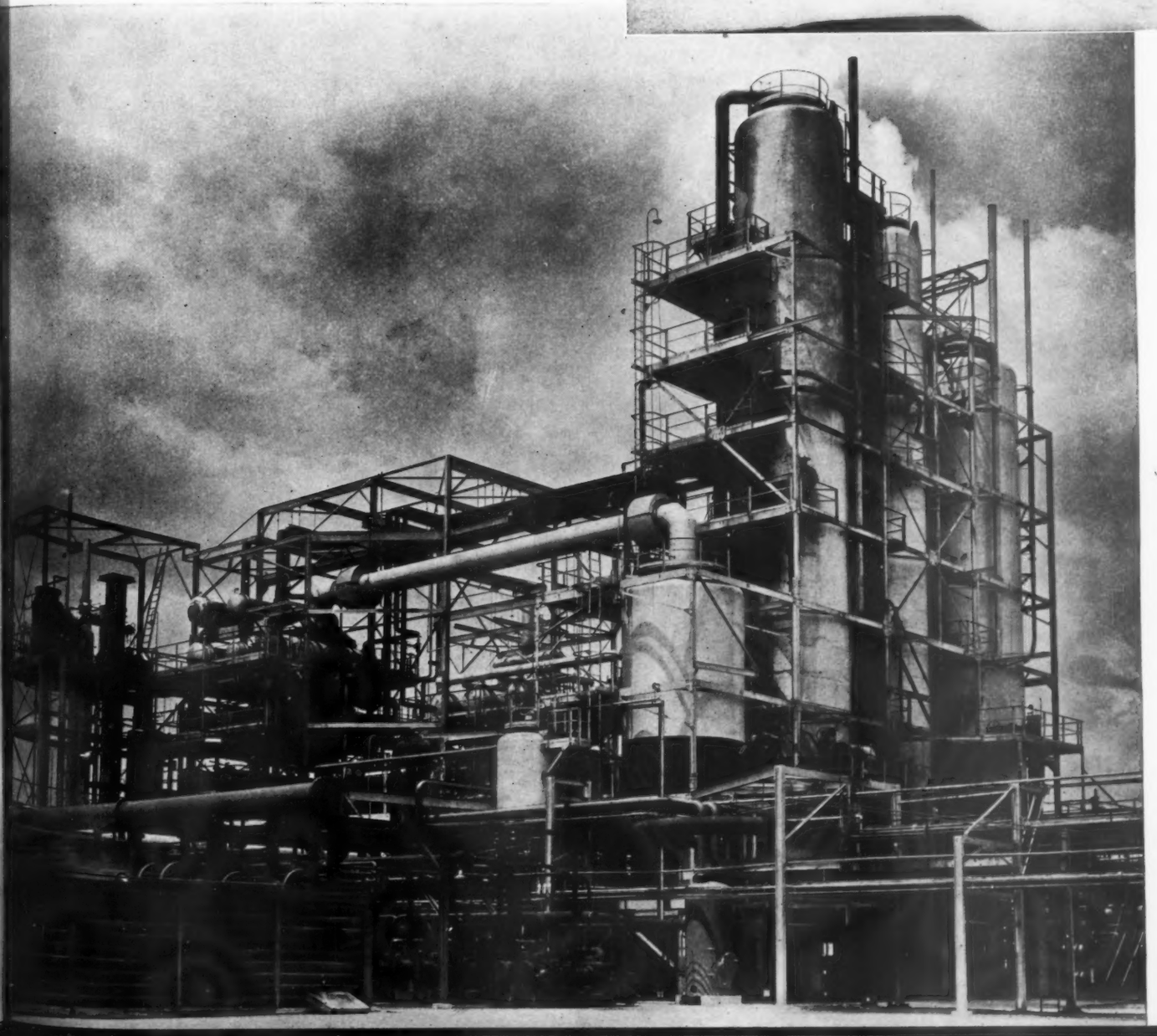
put into effect before such a meeting is held.

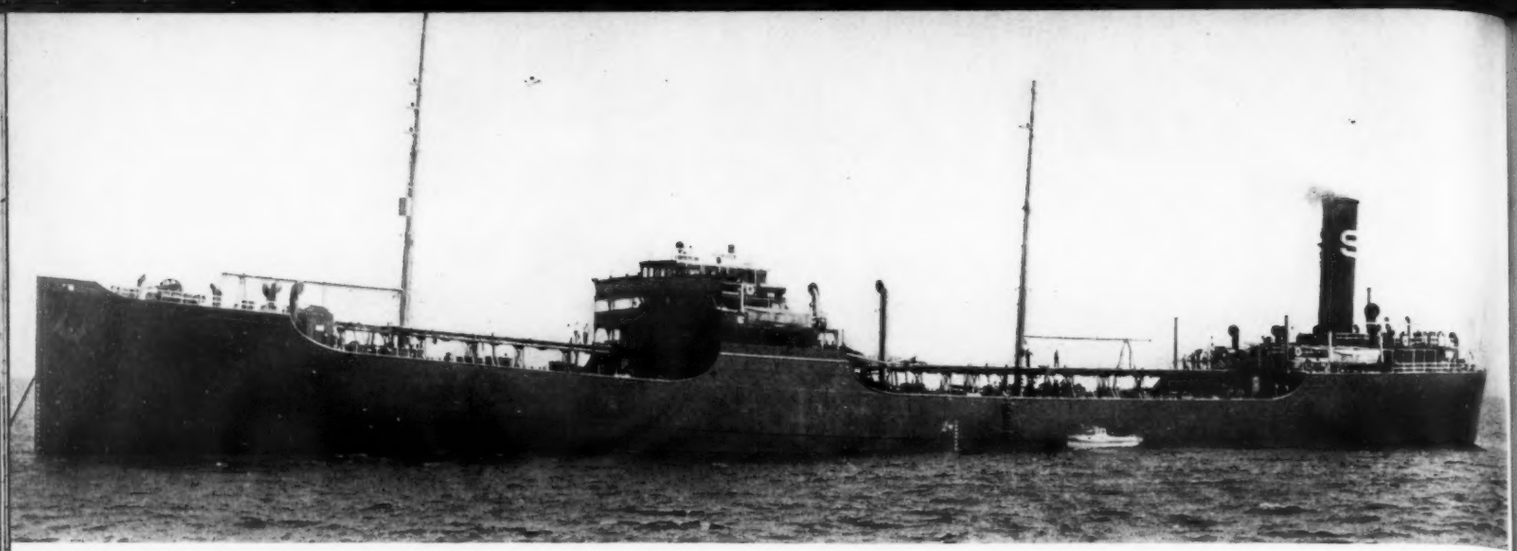
The Federal Social Security Act initiated a universal government plan for retirement pensions. Socony-Vacuum has had a pension plan, for over 34 years, however, and its present provisions are more liberal to the employee than the Federal Act. Pending a determination of the final status of the Act, the company has, therefore, decided to retain its plan in unmodified form at least through the year 1937.

Vacations with pay, and sick leave with full or part pay are included in the general policy of the company. When the services of an employee are terminated through no fault of his own, the company pays an allowance of from one week to a whole year's wages, depending on age and length of employment. For those employees who wish to pursue certain studies in approved educational institutions, the company pays part of the tuition if the course of study is successfully completed. Chiefly as a result of a comprehensive accident prevention program, the various departments have achieved a low frequency rate of accidents which is lower than that prevailing in the petroleum industry as a whole.

Although a completely integrated oil company, Socony-Vacuum has been identified primarily as a marketer. In recent years, however, the company has been emphasizing the development of its production facilities. The ratio of its crude production to its total marketing requirements is steadily improving. In fact, reserves—in both oil and cash—have contributed to the strength and stability of the company in a highly competitive industry.

In the early days of the company, its particular competitive advantage was based on keeping a step ahead in the technique of refining. These early lessons have not been forgotten by Socony-Vacuum today. The largest acetone benzol lubricating oil plant in operation is shown above, while below, the great modern combination unit at Beaumont.





The 15,000-ton MAGNOLIA is among the most modern of the Socony-Vacuum fleet.

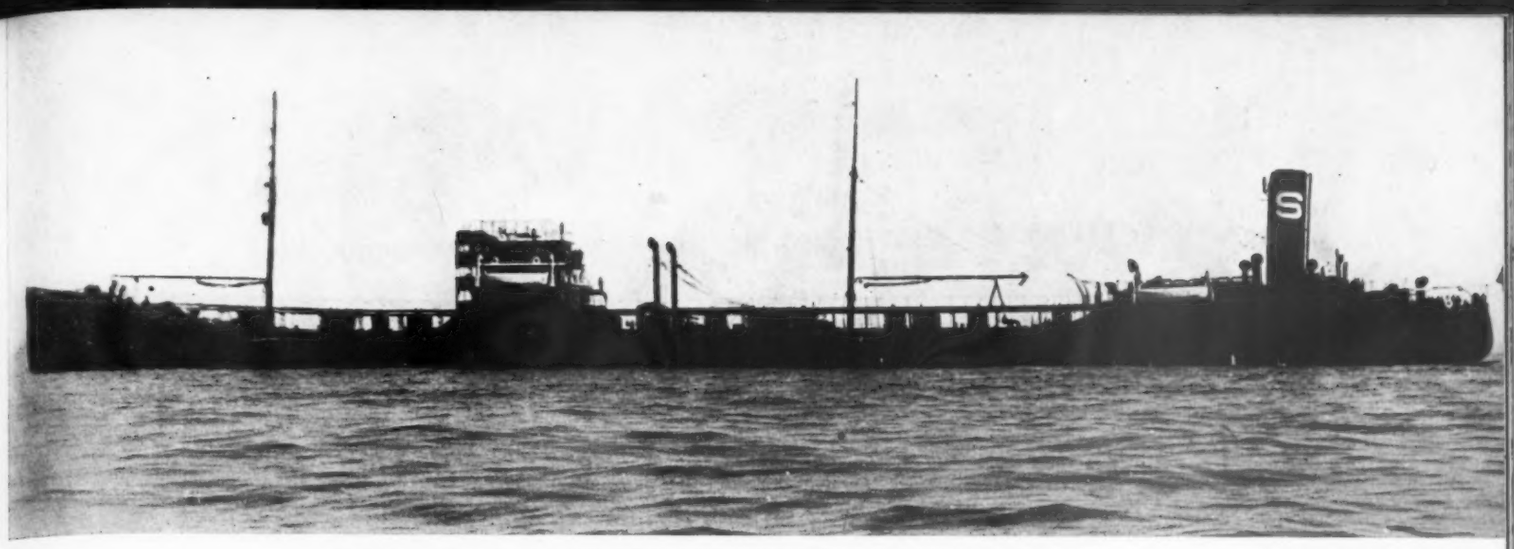
SOCONY-VACUUM'S 500,000 Ton Tanker Fleet

THE oil tanker fleet of Socony-Vacuum Oil Company, Inc., is one of the largest and most efficient under the American flag, its salt-water vessels exceeding 500,000 tons deadweight. Recent addition to the fleet of the MOBILOIL and MOBILGAS now makes a total of 45 tankships, aggregate deadweight tonnage amounting to 558,008, operating along coastwise routes between Texas Gulf and Eastern ports of the United States and intercoastal to Pacific Coast ports. Speeds range from 8 to 13 knots under normal service conditions and deadweights from 1,606 to 15,500 tons—the respective averages are 10.6 knots and 11,700 tons.

In addition, the company operates a large tanker fleet in international trade.

The company is very active in New York harbor, and the annual tonnage carried is one of the largest in that port. The New York State Barge Canal and Great Lakes also see many of the Socony-Vacuum bulk-oil carriers, and for these two services the company operates some twenty self-propelled steel tank barges and sixteen comparatively large boats which are classified as launches. Besides these there are twenty-three tugs, forty-seven non-propelled steel tank barges, and fifty wooden dumb barges for transporting petroleum products in cases and barrels.

Largest of Socony-Vacuum tankers, the MOBILOIL joins the line-up of ships unloading at Port Socony.



The motorship DAYLIGHT, which established a fine record on its maiden voyage.

Not the least interesting of the Socony-Vacuum vessels is the motor tanker DAYLIGHT, which was built in 1931—together with a sister ship BRILLIANT. These are 14,500-ton deadweight vessels driven by 4-cylinder Diesels, of 2,800 brake horsepower, at 11 knots. On her maiden voyage the DAYLIGHT established a very fine record. Sailing from New York on November 17, 1931, she completely circumnavigated the globe and arrived back again on April 4, 1932, having touched Beaumont, Texas; Bombay, via Cape of Good Hope; Karachi; San Pedro; and Colon. Her average speed at sea was 10.25 knots with an average daily fuel consumption of 11.55 tons. Her log shows that no time was lost at sea, and with a running time of 123 days, 12 hours, and 58 minutes she travelled a total distance of 30,390 sea miles. When, after completion of this voyage, the owners received a wire from the builders asking what repairs she would need, they replied, "None."

The two new vessels, MOBILOIL and MOBILGAS, are propelled by geared-turbines with water-tube boilers, driving their 15,500 deadweight tons at 13 knots loaded service speed on a daily consumption of 26 tons of oil fuel. This compares with the 12,600-ton deadweight ships built in 1920, which are equipped with Scotch boilers and reciprocating engines running at 10.5 knots on 32 tons of fuel oil per diem. The new tankers have a shaft horse power of 4,000 against 3,000 indicated horse power in the tankers built sixteen years before.

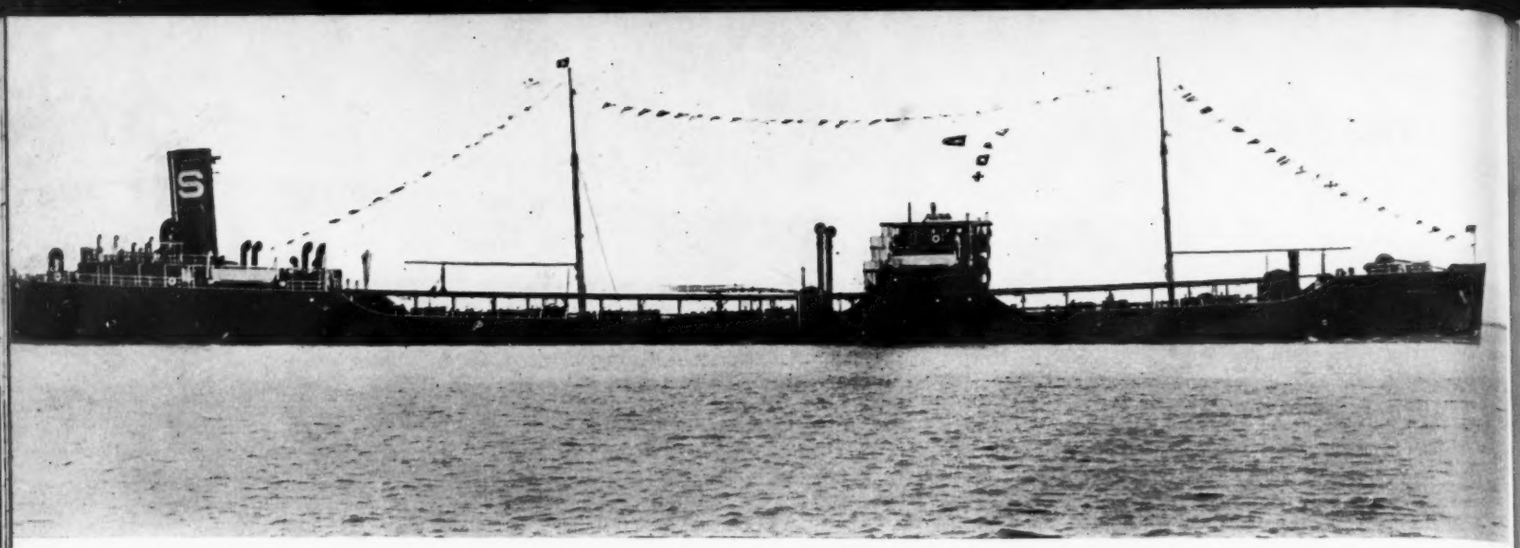
In external appearance at least the two sister ships are the same as the MAGNOLIA; although of similar length and draft their greater breadth gives them an increased deadweight capacity. They have two parallel longitudinal bulkheads extending through the cargo space, and are constructed on the bracketless longitudinal system of framing. While of standard single-deck type with moulded cruiser stern, the stem, masts and funnel are all smartly raked to present an attractive appearance.

Arrangements of these tankers involve several changes from previous designs. Greater electrification of auxiliaries renders the machinery installation very compact. Savings in weight from this cause and increased capacity due to special hull form make them larger cargo carriers than other vessels of corresponding dimensions.

Transverse bulkheads number sixteen, dividing the hull into seventeen oil-tight compartments, each cargo tank being further subdivided by the twin longitudinals.

The main cargo suction lines through the side tanks are 10-inch, and that along the center-line is 12-inch. These three mains are each paralleled by a 4-inch stripper line. Four rotary cargo pumps, driven through single-reduction gearing by steam turbines, are located in the midship pumproom, two of which have capacities of 2,700 bbl. per hour against a head of 100 pounds per square inch

Cleanliness and neatness of tanker decks is typified by the MOBILOIL.



Latest and most up-to-date of Socony-Vacuum vessels—the MOBILGAS.

and the other two deliver 1,500 bbl. each under corresponding conditions. Two pumps of the same type and drive are situated in the pumproom forward, one of 2,700 bbl. capacity and the other 1,500 bbl. All six pumps are together capable of handling the total cargo capacity in ten hours.

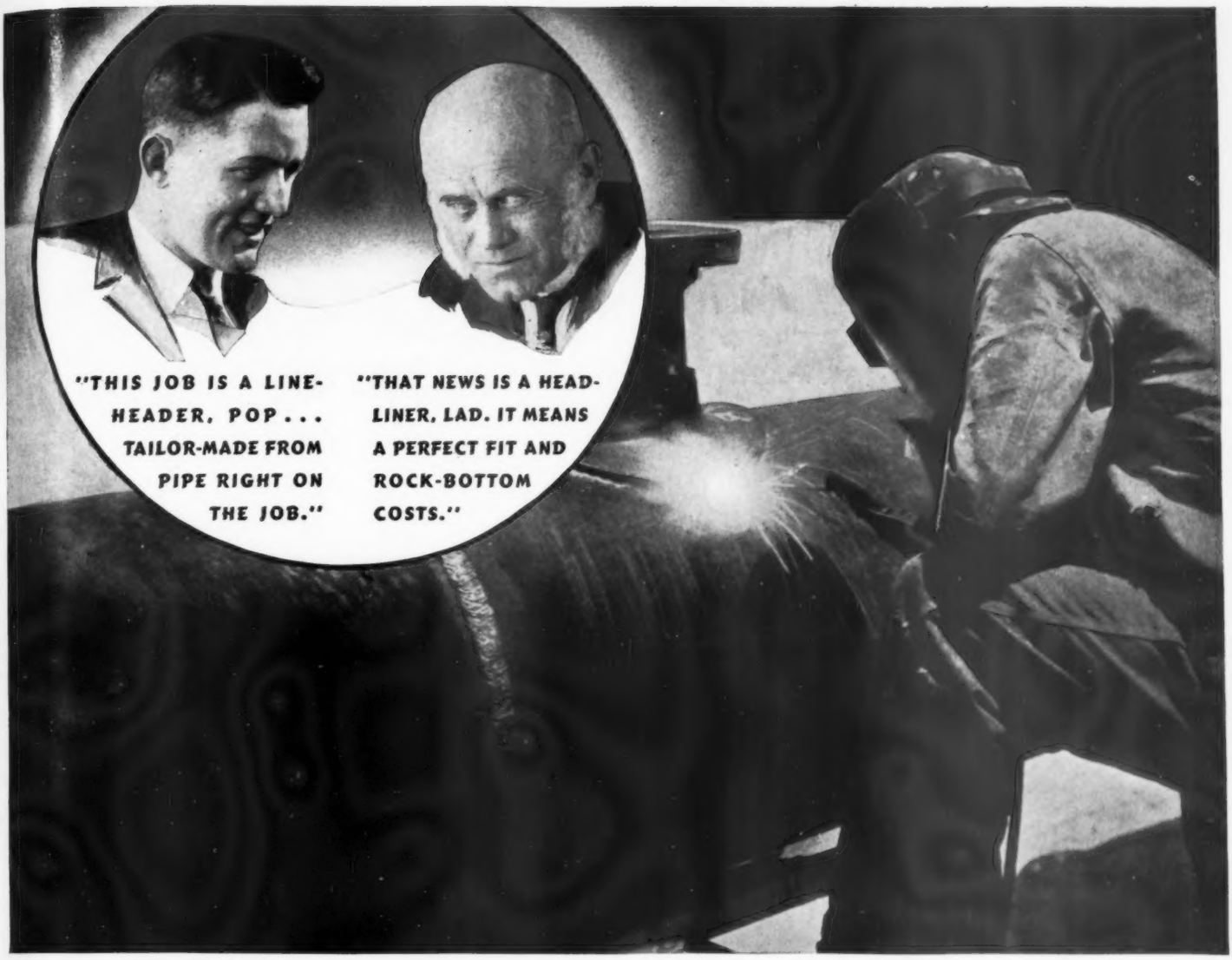
The MOBILOIL and MOBILGAS are notable in that they are among the first four vessels under the American flag in salt-water service to be equipped with welded boiler drums. Welding was done in accordance with the stringent regulations imposed by the government and was based on experience with drums welded for American naval vessels. They are stress-relieved and x-rayed to remove any doubt as to the welds.

Propulsion is by the same reliable cross-compound turbine unit rated at 4,000 shaft horse power which has attained such an enviable record in several recent American tankships. The high-pressure turbine rotor turns over 5,480 r.p.m. at a normal load, and has eleven stages—the first being of velocity compound type and the rest of impulse type. The power is transmitted to a built-up propeller, with semi-steel hub and four manganese bronze blades. The blades are streamlined, with variable pitch, and absorb the 4,000 horse power at 75 r.p.m. when travelling at 13 knots.

Accommodation is of the best, and every effort has been made to insure that these vessels are good fire risks. Wood has been entirely eliminated, and all furnishings and other equipment are of either all metal or fire-resistant materials. The captain's suite consists of a large office, spacious bedroom and adjoining bath on the upper bridge deck, where also is housed the radio room. Below are sleeping quarters for officers, purser, and wireless operator each with its private bath, together with dining saloon, pantry, and gyro room. Abaft the machinery housing on the poop deck are provided bedrooms for the chief engineer and assistants, each with its private bath; all the rest of the crew have quarters with baths and other sanitary facilities on the main deck below the poop. Not more than four men are accommodated in a single room.

The fleet is equipped with all modern navigation aids such as gyrocompass, fathometer, radio, and radio direction finder.

Looking from the Port Captain's office at the company's Staten Island terminal.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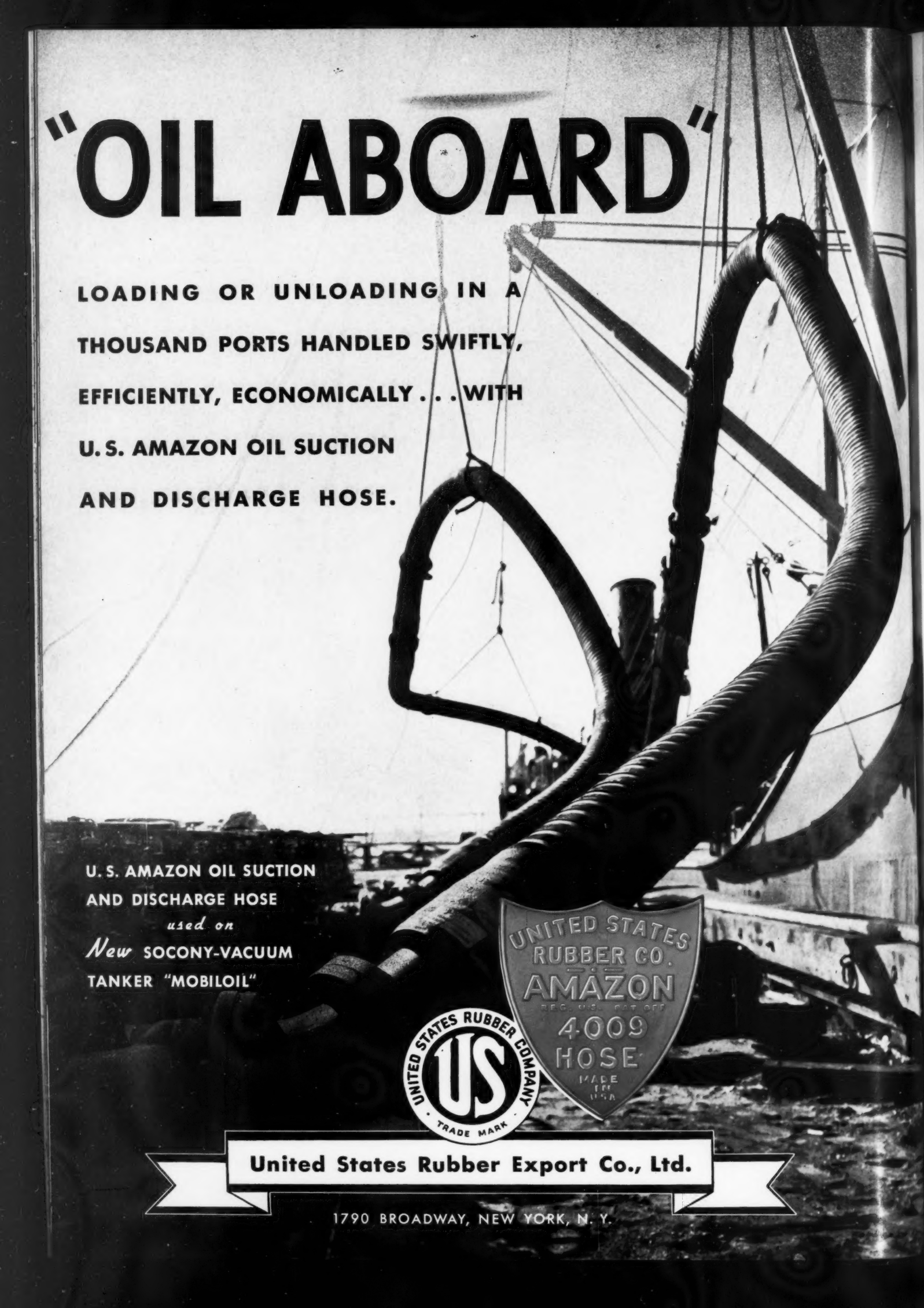
OF A CENTURY
GASOLINE INDUSTRY

GASOLINE MANUFACTURER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Loading Soviet oil at Batum for export: today, internal requirements and failure to meet production schedules are curbing the amount available for export.

RUSSIAN EXPORT POSITION

Endangered by Bureaucratic Control

FIVE years ago the growth of oil production, and particularly the rapid increase in the volume of exports from the Soviet Union, was looked upon as a serious menace to the stability of the international trade in petroleum and its products. During the five years between 1927 and 1932 Soviet production of crude had doubled and Soviet exports had increased nearly threefold. With the imposing program of the second five year plan before them, together with frequent reports of new discoveries, the suppliers of international markets were genuinely alarmed as to the possibility of maintaining their ascendancy against this aggressive and increasingly powerful competitor. They even went to the length of offering to take the entire export supply of Russian oil up to a certain limit on terms which, as later events proved, would have been far more advantageous to the Soviet interests than to the buyers.

This proposal did not come to anything but, since 1932, the progress which Russian oil output had made up to that time no longer has maintained its former pace. Exports have decreased to less than half the 1932 figure and exports of gasoline have declined to less than one-third their former volume.

One obvious factor contributing to this change has been the growth in domestic demand which increased from 12,500,000 tons in 1932 to 17,000,000 in 1935 or 37 percent. In the same period crude production advanced from 21,400,000 tons to 25,260,000 or 18 percent. Statistics do not explain, however, the failure of production itself to maintain the growth of preceding years in view of the effort and emphasis devoted to exploration and development. In the answer to this question must be sought an explanation of why the Soviet Union, though possessing possibly the world's greatest reserves of oil, has lost its importance as an oil exporting nation.

In 1933 K. Riabovol, then head of Soyousnefteexport, stated that Soviet oil exports had increased sixfold, from 947,100 tons in 1913 to 6,044,200 tons in 1932. He cited this as evidence that in the oil industry it had been possible to equal other remarkable Soviet achievements in building socialism. The reconstruction of the oil industry, he continued, was not an easy task but had been accomplished by the creative initiative of the working class under guidance of the communist party and the Soviet government. The

© Sovfoto

Baku, still the chief source of Soviet oil, despite frantic efforts to develop other new important fields.

proletariat, he proclaimed, had emerged victorious from all difficulties without any assistance from the outside and had attained results which the Nobels, Lianosovs and Mantasheffs were unable to achieve with all the help they had been able to draw from outside.

The Soviet share in world production of crude oil (in percent) was shown in comparison with that of the United States as follows:

	1928	1929	1930	1931	1932
U.S.A.	68.1	67.9	64.0	62.9	60.6
U.S.S.R.	6.4	6.7	9.3	11.6	11.6

Compared with production of the Shell group Soviet figures were shown to have increased similarly:

	Shell production	Soviet production
	Percent of world total	
1923	16.0	4.0
1930	12.0	9.3
1931	10.5	11.6

The Soviets, it was further pointed out, had progressed in geological research, drilling and prospecting and had expanded the oil lands at Baku and Grozni. Formidable deposits had been discovered outside the Caucasus, over vast areas of the Ural Emba region, in Middleasia and in other places where the former owners of the oil industry had never dared to step foot. With these successes at hand and others still in prospect, Soviet exports had gained rapidly while oil also had become a factor of importance for the industrialization of the country. Oil exports became increasingly necessary owing to the fact that these exports had offered the Soviets sufficient funds of "valuta" which were required to finance the huge plans for the industrialization of the country at large and the mechanization of agriculture as well as strengthening the defense of the country.

Mr. Riabovol further pointed to the acquisition of distributing facilities on several European markets, necessitated as a counter measure against opposition directed against Soviet oil from certain quarters during the entire period of Soviet reconstruction. The gigantic tempo of Soviet oil development and the acquisition of Soviet distributing facilities, together with the strengthening of friendly relations with some independent groups of Europe and with some governments had resulted in sharp competition against Soviet oil by some of the big oil organizations which had shown particular activity and intolerance, but Soviet oil exports had established a strong foothold and the Soviets were conscious of their strength and ready to counter any attacks undertaken by big or small "Deterdings."

Such was the position of Soviet oil in 1933 when Grozni oil fields had produced during the previous year almost 9,000,000 tons of crude which contained from 20 to 24 percent of gasoline and promised a steady supply of about 2,000,000 tons of gasoline per annum. But Grozni fell out of line. The growth of Soviet crude production slowed down during the period between 1932 and 1935. Grozni production fell to 3,500,000 tons. Grozni refineries, built up to a total capacity of some 13,000,000 tons, required shipment of Baku crude in order to keep the refineries on stream. The bulk of Grozni gasoline fell to about 600,000 tons per annum and the formidable plans of industrialization of the country at large, mechanization of agriculture, increases in transport and aviation, together with defense considerations, required increasing quantities of oil products among which gasoline became an important factor. Home consumption began to grow and exports to decline.

It also became increasingly difficult to market Soviet oil profitably in some of the countries where the Soviets had acquired distributing facilities. In England the cost of distribution has remained almost unchanged when marketing some 300,000 tons per annum as against over 1,000,000 tons in previous years. Exports to main European countries declined and the distributing facilities became a liability instead of an asset.

From Soviet export figures it appears that while in 1932 the export of 2,000,000 tons of gasoline constituted about 34 percent of the total exports of 6,000,000 tons the corresponding ratio for 1935 had dropped to below 20 percent. Evidently the drop of Grozni production caused havoc to Soviet exports. At the same time, however, the share of production in Soviet oil fields outside the Caucasus continued to grow as is evidenced by the ratio in percent of these fields to the total from all Soviet fields, including the Caucasus, which grew from about 4.5 percent in 1932 to about 10.0 percent in 1936. Some of Soviet crude grades outside the Caucasus contain even 40 percent of gasoline. This and the general improvement of refining operation and rationalization of the processes, have not as yet brought any alleviation to the stringent situation in gasoline balances. During 1936 the Soviets were compelled to buy gasoline in California, which was by no means for blending purposes, because the grade of gasoline bought in California was of heavy specification.

The causes of Soviet gasoline shortcomings lie, therefore, in other quarters than the shortage of Grozni production.

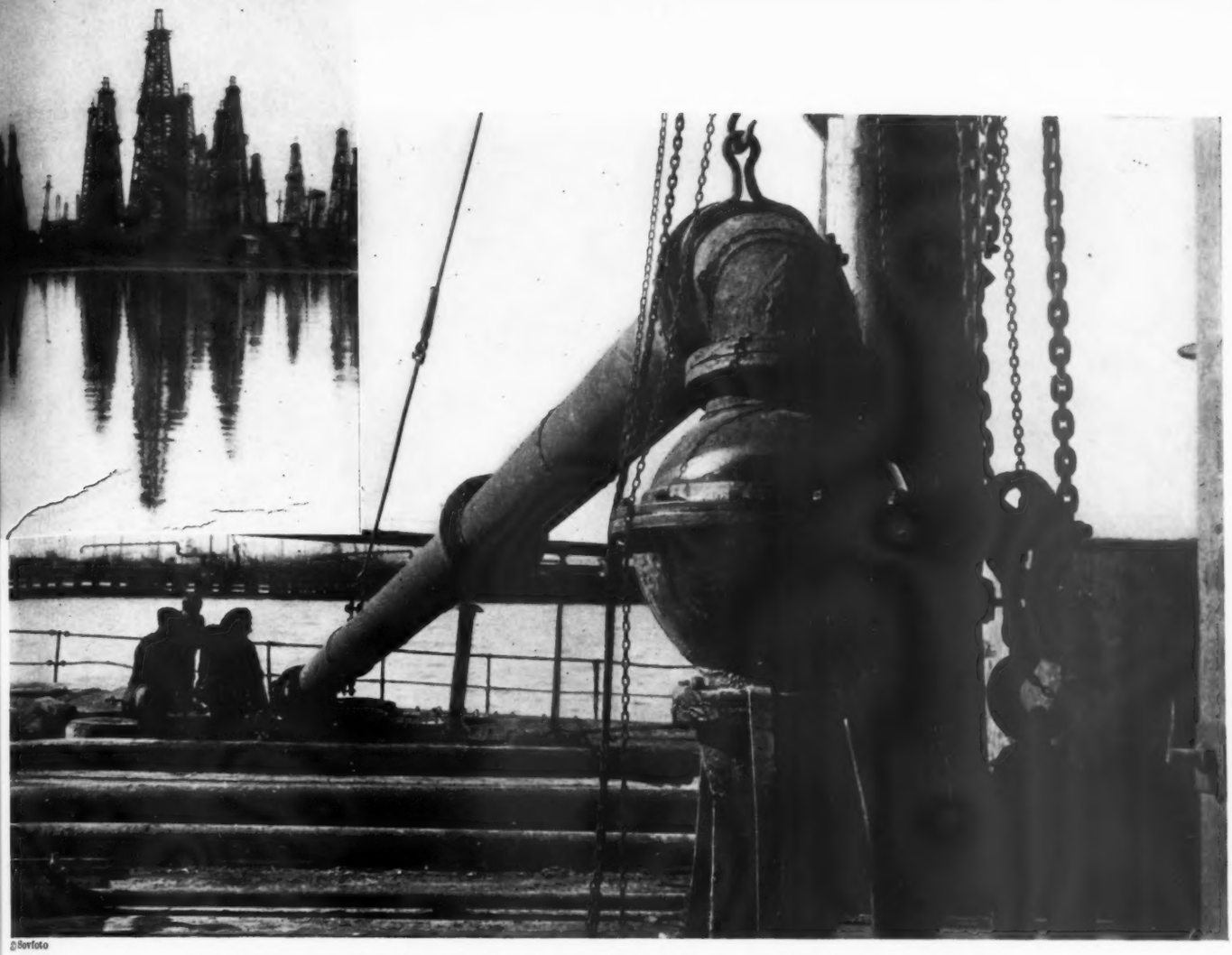
G. Lomov comments on the gasoline shortage in an editorial in "Izvestia" of Dec. 12, 1936 and states that a great deal of waste in gasoline consumption is taking

Table I

Soviet Oil Statistics

(Figures in tons)

	Crude Production	Gasoline Production	Total Exports	Gasoline Exports
1930	18,705,500	1,980,800	4,480,300	1,470,100
1932	21,395,900	2,894,900	6,014,000	2,017,600
1933	21,440,000	2,700,000	4,894,000	1,296,600
1934	24,300,000	2,750,000	4,315,000	1,119,900
1935	25,260,000	2,600,000	3,353,000	658,200
1936	27,700,000	2,900,000	2,700,000	420,000



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From storage at Batum through submarine pipelines to tankers bound for European markets. . . .

place. He suggests that if the 300,000 trucks in use at the beginning of 1937 were adjusted for service with trailers at the rate of 15–18 percent the carrying of useful loads would increase not less than 1,675,000 kilometer/tons which would bring a saving of not less than 300,000 tons of gasoline per annum. Further, G. Lomov thinks Soviet 3-ton trucks, of which the Soviet Union has now 120,000 in use, could easily carry some overload, say 1 to 1½ tons, and if these trucks would carry 4–4½ tons instead of 3 tons the increase of carrying capacity would amount to an equivalent of 30,000 additional trucks which would effect another saving of at least 300,000 tons of gasoline per annum. Likewise GAS 2-ton trucks, of which about 180,000 units are now in use, should be able to carry an overload of ¼ ton which would effect a further saving of about 65,000 tons of gasoline. Carburetors are in dire need of adjustment and of modification in design and construction which might reduce the present rate of consumption by 20–25 percent. This would give a saving of at least 400–450,000 tons of gasoline per year without any detriment to motor capacities.

G. Lomov quotes the Soviet journal "Motor," No. 4, 1936, which criticizes Soviet wastage of gasoline in the form of leakage and evaporation amounting to 10–15 percent. This waste occurs not only in storage, in consuming centers and in transportation, but in the oilfields as well. Soviet consumption of gasoline has grown to about 2,000,000 tons per annum, requiring transportation by rail and water as well as by other means. Evaporation and leakage losses in transportation, if reduced to the maximum extent possible, would effect a saving of 300,000 tons of gasoline per annum. Mr. Lomov also suggests blending of gasoline with alcohol to accomplish another saving in motor fuel of at least 200,000 tons of gasoline per year.

Another phase of this subject is the waste of fuel, not only oil but other kinds as well, in industrial plants. "Za Industrialization" of June 15, 1936 comments on such waste and tells the story of a Moscow plant—a large consumer of fuel—which offered some 800 tons of coal waste for sale. The paper said that while the quantity was negligible and the quality poor, the fact that a consumer of fuel had also become a trader attracted the attention of the authorities with the result that the deal was stopped and the management punished adequately. But this tends to show how badly rationalization of fuel is organized in the way of distribution and proper allotment. The country re-

TABLE II

Soviet oil exports by Countries (tons)

	1930	1931	1932	1933	1934	1935
Italy	826,200	1,079,700	1,055,900	998,700	622,099	205,438
France	556,800	837,500	967,200	719,200	730,491	413,147
Germany	504,700	399,300	540,400	505,500	458,630	489,220
Spain	361,300	123,200	431,100	342,200	493,546	178,462
England	973,100	1,084,400	621,600	312,400	452,793	328,217
Belgium	103,600	272,500	277,900	259,700	148,144	119,262
Sweden	38,400	171,200	271,600	218,600	153,234	148,068
Denmark	95,300	109,100	103,000	122,500	158,348	100,606
All others	1,343,700	1,147,400	1,837,300	1,415,700	1,098,101	1,371,344

© Sovfoto

Loading a tank car with Russian oil.

quires a total of about 150,000,000 tons of fuel. The saving of only one percent means 1,500,000 tons of fuel values. The consumption norms established at pig iron plants vary greatly between one establishment and another. Makeevka consumes .987 tons of coke per ton of pig iron, while Magnitogorsk consumes .961 tons and other plants consume 1.267 tons. In the United States the average rate is .880 tons and in German plants the consumption is as low as .820 tons.

Similar discrepancies are found in consumption by steel mills. The average fuel value used per ton of steel in Soviet Russia is 270 kilograms or 210 kg. by the most modern Martin furnaces of Makeevka, while the corresponding consumption of German plants averages 180 kg. The Soviet coking industry exceeded the plan for fuel consumption during the first quarter of 1935 by 150,000 tons of coking coal. Soviet electric power plants are large consumers of fuel. They rank first in the list among the consumers of the heavy industries (⅓ of the total). While the consumption of fuel per KWH has been reduced from .773 ton to .684 ton at some individual plants, the average for the greater number is .800–.900 kg. while the average for the United States or Germany is .47–.45 kg.

With the growth of a giant bureaucracy the fanatical zeal of those who pioneered communism in Russia has weakened. Enjoyment of luxurious living at home and abroad has had the effect of moderating devotion to principle but has increased the desire for retention of position and power. Added to this is an apparently irresistible temptation to interfere in political affairs in the countries in which the Soviet engages in commercial operations. This has aroused opposition and in some instances has placed the Russians at a disadvantage in competing with non-political concerns. Nothing on the horizon indicates any improvement in the system of organization and control.

Another consideration: acceptance of responsibility without political pull may prove dangerous. If things do not go smoothly those who are in this position may be punished as saboteurs. There are many trials in Russia—and the most frequent charge is sabotage. Coal production is short of plans —the engineers are tried for sabotage. The oil industry goes wrong—sabotage. The refrigerating industry does not work and food rots in the country while the cities and villages starve—the technical directors are tried and shot for sabotage. Railroads break down or chemical industries fail to live up to plans—trials follow and someone has to taste bullets. Oil fields are exhausted as predicted by able geologists and the geologist is no more. Trials, removals and replacements follow one another without end. Socialist industrialization invokes human sacrifice to insure harvests, pig iron production, coal, oil and tractors, just as was done in ancient days for the ample supply of goats and lambs and wheat and rye and wild grapes. Superstition has been wiped out in Russia together with religion, but they have been replaced by a political creed which is inextricably mixed in industry and business. The industrial program is ill because it is being lubricated too much with blood instead of machine oil. To assume responsibility is dangerous. Suppose nobody will take the responsibility for an adopted plan; their not taking responsibility becomes sabotage and this story repeats itself indefinitely with the result that unproductivity is excessive, inefficiency reigns and all plans and schedules fail.

Table III

Soviet Oil Exports

(tons)

	Total	Gasoline
1930	4,480,300	1,470,100
1931	5,280,000	1,658,100
1932	6,014,000	2,017,600
1933	4,894,000	1,296,600
1934	4,315,000	1,119,900
1935	3,353,000	658,200

The Kalinin machine building works of Moscow delegated representatives to visit the United States to study methods of industrial operation and organization. They report that American plants corresponding to the highly modernized Kalinin works are better organized and less complicated. In Soviet plants modern equipment is treated in Asiatic and barbaric ways and men are not always placed in the right positions. Too many are employed at sinecures or doing office work. Technical charts are turned out profusely but nobody uses them. The producing teams have too many assistants and helpers who hinder more than help.

Table IV

Soviet Consumption

(tons)

	Gasoline	Kerosene	Lubeoil	Total
1930	228,000	2,000,000	280,000	9,000,000
1931	400,000	2,150,000	480,000	14,000,000
1932	800,000	2,260,000	850,000	11,000,000
1933	1,095,000	2,350,000	1,020,000	13,835,000
1934	1,501,000	3,447,000	1,125,000	15,506,000
1935	1,650,000	4,000,000	1,150,000	17,100,000

"Za Industrialization" of Dec. 28, 1936, telling the above, takes also the opportunity to compare the Soviet Kalinin plant (builders of oil pumps and turbines) with the corresponding works of the Byron Jackson Company in the United States. The pump manufactured in U.S.S.R. weighs 1,210 kg. and operates at 55 percent efficiency. (This plant is trying to follow American standards by reaching an efficiency of 79 percent and reducing weight to 500 kg.) If all pumps produced in this plant during 1936 were put

under operation for 20 hours per day the waste or excess consumption of electricity would have amounted to 200,000,000 KWH.

Employment at Kalinin works in U.S.S.R. compared with Byron Jackson Company in U.S.A. is as follows:

	Kalinin Works Moscow	Byron Jackson
Production operators	489	450
Help	581	70
Engineers Technicians	231	35
Accounts office work	122	55
Service	65	12
Administration Political Service	169	none

Previous articles dealing with conditions in the Soviet oil industry have described methods of operation in drilling and production as well as conditions of labor liquidity. An inquiry into the qualifications of drillers showed that of about 400 drillers at Grozni more than half were illiterates, many semi-illiterates and only 27 drillers were old timers who had been employed over five years. Housing conditions are bad, transportation is invariably out of order and labor is in a constant state of flux. When attempts are made to hold workers on a particular job by order they find a way out by committing some minor misdemeanor such as coming late to work, but how be in time when transportation is irregular? During hot summer days either drinking water is lacking or if there is water there is no ice to cool it and on pay day a long line of labor leaves the fields of employment for good. On the problem of labor liquidity the Soviet paper "Za Industrialization" of Dec. 15, 1936 tells a story how the Snejnia anthracite trust hired 24 laborers for its Stalin mine No. 18 and how these 24 men left this employment the same day in order to find work elsewhere. Neither the party authority nor the regional organization took the slightest notice of this fact, because everybody in the Don coal basin is used to the continual shifting of workers. During 11 months of 1936 a total of 231,000 laborers were hired in the Don basin and 233,000 left this employment. During 1935 the labor turnover amounted to 211,000 hired and 219,000 left. In 1934 a total of 199,000 were hired and 210,000 left. These facts, the journal says, pass without much attention and everybody knows how labor liquidity affects efficiency. Because of the high rate of labor liquidity it has become a common occurrence to replace highly qualified positions with new hands not as yet trained for the particular jobs and often such positions are filled with men untrained at all.

Position of Labor in Two Soviet Industrial Organizations

	Snejanthracite trust	Stalin Metal works
Total labor	11,790	10,596
Men employed less than 1 year	5,078	2,113
Empl. 1–2 years	3,514	3,323
Empl. 2–5 years	1,776	1,040
Over 5 years	1,422	4,119

No wonder then that labor productivity is low and efficiency an unknown factor.

Over a number of years when oil exports were good, because of world market prices and an abundance of gasoline supplies, all gasoline of low specification was turned over for home consumption, but as the years passed the Soviets found out that it is unprofitable to gain on exports and lose much more by using inferior gasoline on all motor cars, trucks, tractors and combines. As of today, even with considerable increases of the refining capacities and improved refining methods, not much high grade gasoline is left for export. Soviet gasoline ranks below American grades and this is not difficult to understand when one realizes the slow pace of modern progress in Russia. The Soviet oil industry follows the latest developments in technical progress but is always two to three years late. It takes from six to eight months to form a commission of inquiry and study, for only men highly qualified politically are accepted for the issuance of foreign passports. Such commissions spend another six to eight months making studies. Another half year is spent in reporting and making decisions about the equipment to be installed. Thus when orders are placed and delivered within the next six to eight months a plant that was thoroughly modern at the beginning of this procedure has come to be considered obsolete elsewhere because of new methods devised and new progress made. It must be said that some Soviet engineers are capable and ingenious but who will take responsibility and dare to suggest innovations? Since Winkler Koch cracking was adopted in Russia some five years ago Soviet engineers have modified the construction by a two furnace system. So far, however, only one installation has been erected at Baku—for testing purposes. Dubrovaya designed a vapor phase cracking system some five years ago. Today it is still under test. Electricity has been ordered for all Soviet drilling and field operations and steam as well as any other means of power has been practically discarded. The Barinoff commission found that the United States is using steam and gas motors extensively and now the use of electricity without steam or gas motors has become discredited in Soviet fields. Too much regimentation and too drastic martial laws kill initiative. With the breaking down of individuality men become robots and see no inducement for improvement.

Discussion, investigation and original work on the theoretical side of industry are all encouraged. When it comes to practical operation the difficulties presented by the lack of trained or trainable labor and the risks involved in the display of initiative that may fail to reach the announced goal are greater than the average man cares to assume.

Railroad station at Surekny oilfield facilitating the extraordinary rate of labor turnover in Russian oilfields.

Sovfoto

A rotary drilling rig in use about 27 years ago.

MANY IMPROVEMENTS

Required in Modern Rotary Drilling Equipment

By J. E. Brantly

COMPARED with other basic industries and because of the many unknowns involved, the production of petroleum is, probably, comparatively far more costly than the winning and producing of any other major natural resource.

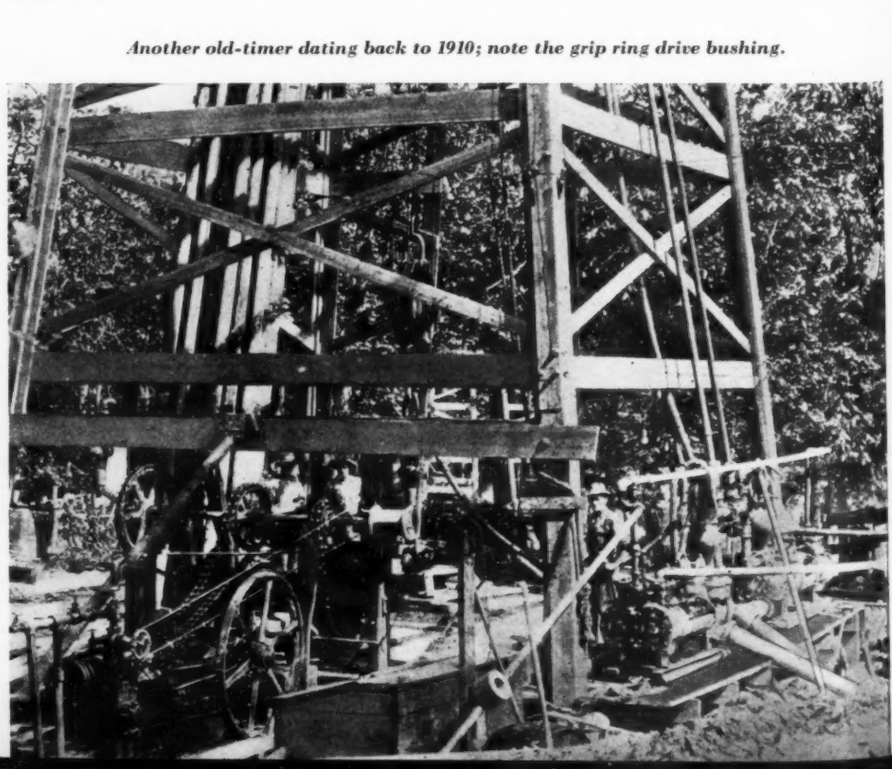
In so important an industry it is absolutely essential for reasons of conservation, as well as for immediate profit, that the utmost economy be practiced. There is no department in the oil producing industry that is not subject to and greatly in need of very careful review and improvement in its functions. This discussion has to do with one rather small segment of the whole, the improvement of oil well drilling equipment.

While criticizing freely—at times perhaps severely—the manufacturers and users of rotary drilling equipment, the writer is not unmindful of the splendid work already done by each group in developing and proving new machines, equipment and drilling technique. There still remains much to be done, however, and it is hoped that this entirely friendly criticism will be helpful in stimulating continued and deeper interest in more efficient tools.

Rotary drilling, or the method of boring holes into the earth by means of a drilling tool or bit attached to the lower end of a hollow shaft, through which fluid is forced for the purpose of removing the cuttings from the hole and cooling the bit, came into general use in the oil industry in the old Spindletop field on the Gulf Coast about the year 1902. The principle of operation substantially antedates that time, going well back into the nineteenth century. The late Captain Anthony Lucas was responsible for drilling the original wells and discovery of the Spindletop field, and it is most unfortunate that the original rotary rig was not preserved for the edification of future generations. It consisted of equipment almost identical in general design to that in use at the present day and, with a few exceptions, which will be mentioned, radical changes have been made neither in the general plan of operation nor in the machines themselves. It may be true that no improvements are possible, or that the mechanical equipment and practical operations of that day were the results of technical ability in the design of machinery, and skill in its use, that have not as yet been surpassed. But this is questioned seriously. It would seem that were the machinery and

J. E. Brantly, president Drilling and Exploration Co., Los Angeles: from a paper delivered at the annual meeting of the A.I.M.E. Reproduced through the courtesy of *Mining and Metallurgy*.

Another old-timer dating back to 1910; note the grip ring drive bushing.



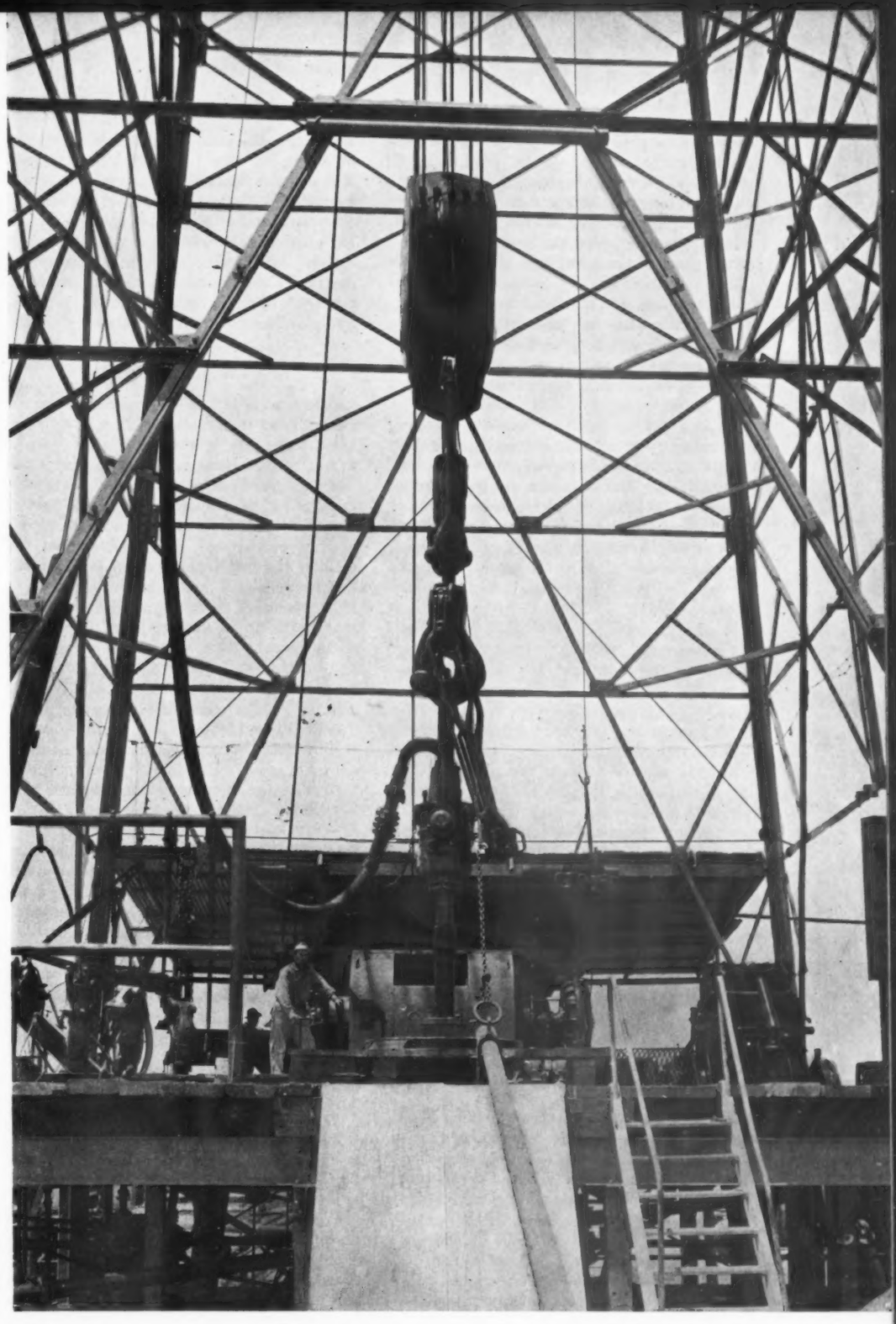
equipment for the drilling of oil wells designed and built with engineering and technical ability, skill and practical knowledge equivalent to that found in the usual steam and electric power plant equipment and in various and sundry other industries, vast improvement could be made to drilling tools with a resulting economy of operation that would permit the more logical development of many oil fields, resulting finally in the recovery of a higher percentage of the oil contained in the productive horizons. This is the end sought.

The methods of locating oil have been vastly improved by the combined efforts of geologists and geophysicists and, during the process of drilling operations, there is now more assurance of finding a producing sand, if a producing sand is present, by the use of highly perfected core barrels, the so-called "electric coring" instruments, and other electric devices for the determination of the nature of the material through which the bit passes. Testing tools, that actually determine the productiveness or barrenness of a given sand by using the drill pipe as temporary oil tubing, are likewise available, but still the equipment and tools used for the actual drilling are of the same pattern and the drilling costs are practically unchanged.

It is true that the boilers now in use carry much higher steam pressures than those formerly employed; the pumps are vastly larger and in consequence much heavier; engines and draw works have larger cylinders, larger shafts, larger sprockets and more of them; and the tables, which actually rotate the drill pipe, are of much better construction than they used to be. But these pieces of equipment, their layout and functions, are identical now to those of more than thirty years ago. In the following paragraphs the drilling rig as it stands today will be taken up in its various parts, and possible improvements suggested. These paragraphs will consider steam driven rigs only, after which a few paragraphs will be devoted to the subject of prime movers other than steam.

Steam Power Plants

An oil field boiler plant for the heavy duty rigs in use today consists of a battery of five locomotive type boilers, or four such boilers and a superheater. The boilers are of the fire tube type, having a fire box surrounded by a water jacket that is an integral part of the boiler and situated behind the fire tubes. This type unit has been in use practically from the beginning and was selected for its relatively simple construction and because no brick or other mounting is required. The largest of these boilers are of 125 horsepower capacity and weigh approximately 18 tons each, which means that the boiler plant fully equipped, has a total weight of about 100 tons. The boiler is identical in general design to those of many years ago, the only difference being in the thickness of the plates and the number of tubes, stay bolts, and rivets.



Modern drilling operations on Gulf Coast; rigs are now constructed of steel, traveling blocks are heavier, swivels improved, hooks more sturdy and satisfactory, but fundamentally the design is the same.

During this period of gradual increase in the thickness of the boiler plates from ½ to 1 1/32 inches, highly efficient water tube boilers of various types and manufacture have been perfected and are being used for the generation of steam at pressures equal to, and substantially higher than, those used in oil field service. It would seem that the principle of the water tube boiler could be combined with that of a fire tube boiler of the locomotive type, or with some other type, resulting in a much more efficient steam generating unit, and one that would produce more pounds of steam per day for each pound of boiler weight. Many of these water tube boilers have their superheaters

conveniently placed in the cooler part of the combustion chamber. It is possible that this practice could be extended to use in an oil field boiler thus displacing the separate superheating unit, or a few lengths of steam pipe occupying the rightful position of the gases of combustion in the upper fire tubes.

Improvements in this most important part of the drilling rig can and must be made. The industry has long suffered useless expenditure of time, energy and money through the use of crude and inefficient steam generating units.

As an argument against a need for change, the boiler used by a locomotive may be sighted as an example, but oil field boilers are locomotive type boilers, and not locomotive boilers. The latter are of much better construction and are used for a few hours only before being thoroughly washed and cleaned. Also, they are handled by thoroughly trained firemen not generally available in the oil fields.

It is common practice in oil field operations to use boiler feed water varying from cold to a temperature that scarcely justifies the term "hot." The warm water is obtained in some areas by passing the exhaust from the boiler feed pumps into the feed water tank, thus obtaining water temperatures approximating 125 deg. F. Some operators in California and others in the Mid-Continent use tubular heaters or heat exchangers, employing as a heating medium exhaust steam from the boiler feed pumps or the mud pumps or both. If the boiler feed pump exhaust only is used, temperatures of about 125 deg. F. are obtained, and heaters or heat exchangers through which the exhaust from the mud pumps is passed raise boiler feed water to temperatures of 140 to 160 deg. F. One manufacturer now has on the market a boiler feed water heater pump that delivers feed water to the boiler at temperatures varying from 180 to 200 deg. F. It utilizes exhaust steam from the boiler feed pump and the mud circulating pumps.

The higher the temperature at which feed water enters the boiler, the smaller the quantity of fuel that has to be consumed in heating the water and generating steam. There are also other important advantages. Therefore, water should enter the boiler at the highest temperature that can be gained by the use of waste steam from the rig or heat from the boiler plant. Exhaust steam from the pumping plant and the drilling engine has adequate heat to raise the boiler feed water to maximum usable feed water temperatures. Therefore, it is important and essential for maximum economy that the waste steam be utilized to the maximum extent for feed water heating, though this is infrequently done.

Condensers are generally used in oil field service along the Gulf Coast where sweet water has to be barged to the locations and where sea water for cooling is present in abundance. Condensers are likewise necessary for economical operation in arid countries where the local water is either very hard or scarce, but they have not been developed. There are no theoretical reasons against such a development and there is little question but that the economy effected in saving and having good boiler feed water will vastly outweigh the carrying charges and operating costs. Where only a small quantity of make-up water is required, its character or analysis does not matter greatly.

Pumping Plants

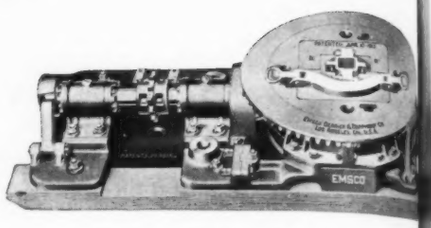
The mud laden fluid circulating pumps in general use today are of the direct acting type, having the steam piston and cylinder at one end of a long rod and the mud piston and cylinder at the other end. Where fuel costs are of no importance and good water abundant, this type unit, because of its fluid delivery characteristics, is ideal for use in the drilling of oil wells; but, where fuel is costly and water is of a quality unsuited for use in boilers without treatment, or where water is scarce, the direct acting steam pump is the most uneconomical piece of drilling equipment imaginable. There have been placed in service within relatively recent months pumping units consisting of power pumps driven by multi-cylinder variable cut-off reciprocating steam engines which show an astounding reduction in steam consumption. For ordinary drilling operations, this type unit will do all that can be desired of any pump. For special jobs, however, where very small fluid volumes and high pressures are required, the direct acting steam pump is still the master and is an essential part of the rig, except where the problems are simple. Apparently then, for economy and all around service, the pumping plant should include a power pump driven by a variable cut-off engine, and a direct acting steam pump to take care of the fluid circulating problems, which involve unusual circumstances. The suitability of the steam turbine for power pump driving and its economy is unknown. Theoretical considerations indicate that experiments and practical field trials are warranted.

Engines and Draw Works

Passing from the pumping plant to the derrick floor, the first machine encountered is the hoisting engine and then the hoist or draw works. Multi-cylinder horizontal and vertical hoisting engines, varying from 10 to 14 inches in piston diameters and strokes, have been perfected to quite a satisfactory point of efficiency, in so far as steam consumption is concerned, though the possibilities of improvement in mechanical efficiency have not been exhausted. These machines have two cylinders, generally, though one manufacturer builds a very satisfactory three cylinder vertical engine, and as prime movers for the usual hoist of the present day rotary rig they may be dismissed as being satisfactory for present purposes.

In front of this engine is placed the machine that carries the drum, around which the drilling or casing line is spooled, and which serves the purpose of lowering and hoisting the drill pipe and casing into and out of the hole. These machines have two shafts, as they had 30 odd years ago, or three shafts as has been developed within recent years. There are seven or eight sprockets, generally cast, though recently a few are being ground or cut. The shafts are from 6 to 11 inches in diameter, running on antifriction so-called "self-aligning" bearings placed as far apart as practically possible, apparently in order that the shaft sizes may be made larger without destroying the symmetry of the compilation. Single width chains, built with some degree of precision, of steels of varying degrees of hardness and brittleness, run on these several sprockets. More recently, double width chains have been developed as though with the thought in mind that single width was not giving quite as much trouble as was possible, but probably this will prove to be a substantial improvement. All chains should run in oil. The brakes are of the common band type and of an effectiveness hardly exceeding 50 percent of the possible area of the braking surfaces. The materials of the linings are a compromise between the necessity for stopping and holding the load and the desire to feed the bit into the formation with some degree of smoothness. Square shouldered jaw clutches are used for engaging the drum with the prime mover through the sprockets and chains.

Such a piece of equipment as the usual draw works, even of the most improved type, is obviously the optimum of inefficiency and crudeness. The engine, which is relatively delicate and finely machined, or at least it should be for efficiency, is connected to the load bearing drum shaft by positive chains. As the square clutches are engaged, the engine is subjected to unnecessary shock and



Rotary machine, 1922–26.

Rotary machine, 1937; many refinements and improvements have been made, but the basic principle remains unchanged.

the finely tempered chains are required to stand more than should be expected of them. At the same time the drilling or casing line, which frequently is being subjected to labor that allows a very small factor of safety, receives unreasonable and unsafe stresses, resulting in premature fatigue. The very high speeds at which chains are presently run are substantially beyond those at which good effective service can be rendered. The brakes and brake flanges, necessarily serving dual purposes, are neither all that is required for braking service, nor everything that is desired for feeding the bit into the formation.

Improvements in this extremely important part of the string of rotary drilling tools are vastly important, and essential for efficiency comparable to similar machines used in other industries.

Gear driven hoists have been built and are rendering excellent service. Friction clutches are possible and are now in use. Braking systems can be designed to provide full effective braking surfaces, and materials offering a proper coefficient of friction for braking and holding the load are available. All of these principles of construction or design are in use today on highly successful machines used for various purposes, including the boring of holes into the earth, and their development for general oil field service should be undertaken.

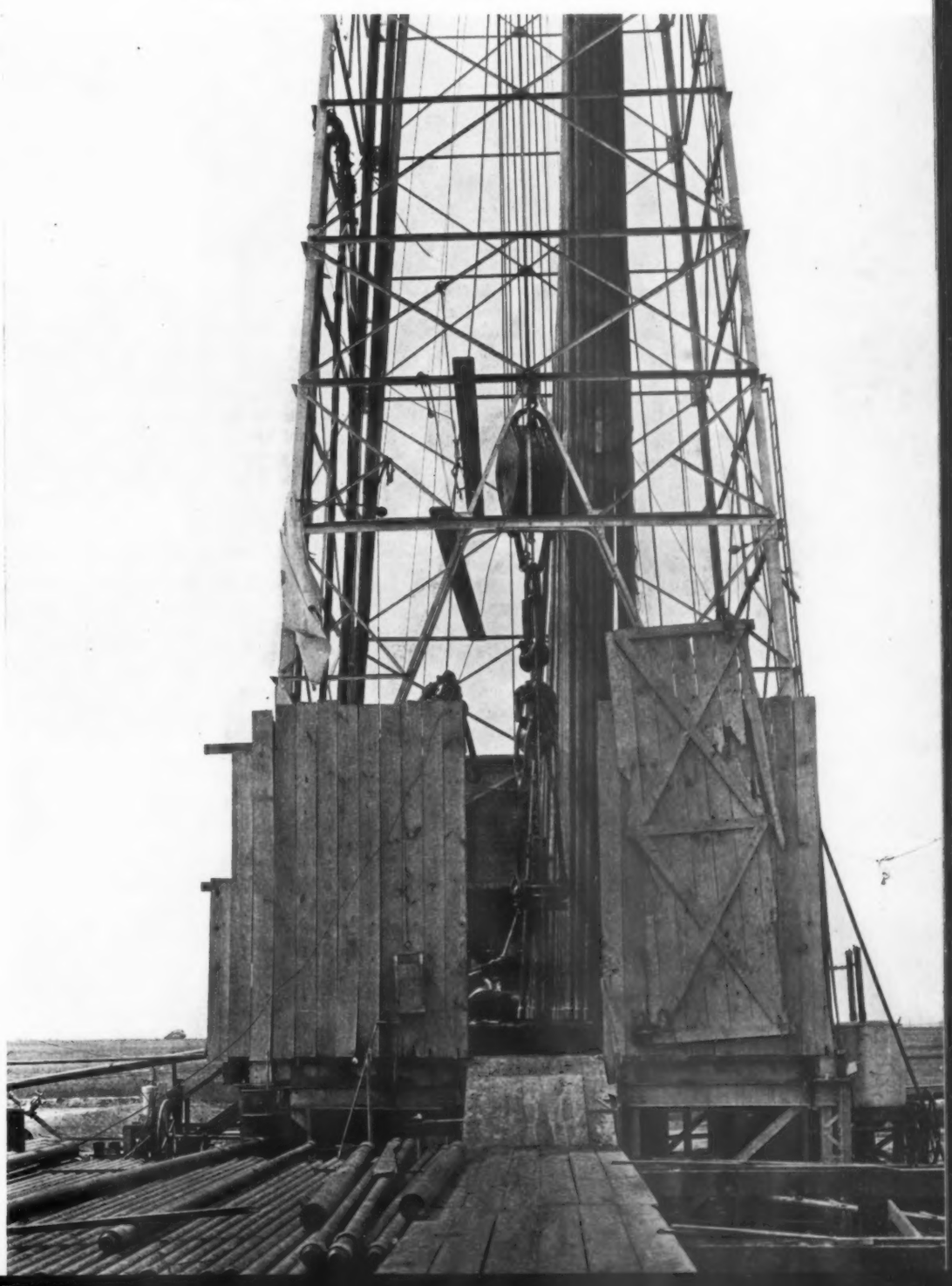
The manufacturers, as a first argument, offer the proposition that gears either cannot be built for the speeds necessary or are too costly and that friction clutches cannot be developed to serve the purpose required by the hoisting drum. But these statements are lame excuses rather than reasons. Satisfactory gears can be and are being built, and friction clutches carrying greater loads are in daily use. For brakes, the argument is that those in service at the present time are doing the job, and that different types would be more complicated and more costly. Possibly they would be higher in first cost, but it seems certain that the saving in lining wear, brake flange wear and cracks, together with a much more delicate braking action would substantially offset the higher initial cost.

Rotary Tables

The rotary table as constructed seems to be a very satisfactory piece of equipment though the conventional method of driving is neither satisfactory nor economical. By the conventional method is meant the chain drive from the overpowered (when used for rotary power) hoisting engine, through the heavy Jack shaft and rotary drive sprocket and along the chain to the table sprocket. There is a tendency to build tables unnecessarily large which means more bearing trouble at the present high and future higher rotating speeds.

The most delicate tool in the drilling of a well is the drilling shaft, or as more commonly called the drill pipe. It is being rotated by a very large engine through heavy rotating parts and a long chain and thence to the table drive shaft. If the bit on bottom suddenly encounters hard formation or a "shoulder" it may be stalled and if the rotating mechanism has sufficient momentum the drill pipe is wound up until its length is shortened sufficiently to pick it up over the shoulder or until sufficient torque is developed to break the material away. In either case the drill pipe is subjected to stall shock and sudden release, both of which are conducive to metal fatigue and premature failures. In other words, a job that requires relatively little power is being done with a greatly overpowered prime mover through heavy rotating parts in which substantial energy is stored. Also, in order that the table may be driven at the necessary speeds for reasonable penetrating efficiency, the chain is being considerably overrun and is subjected to frequent failures with consequent costly shut down time, as well as chain replacement. This type drive to the rotary sprocket, which is generally outboard on the new tables, has a constant tendency to pull the shaft and bearing out of alignment and, in consequence, also the pinion and ring gear and the remainder of the table. Thus, this type drive is costly in drill pipe fatigue and failure, bit breakage, chain wear, and rotary table wear. The obviously proper method of rotary table drive is by a prime mover properly powered and geared to drive the table in such a manner that the machine will be stalled before subjecting the drill pipe to undue fatigue in the event of bit stalls, to

A modern rotary drilling rig: Shell Petroleum Corporation's Kratzer No. 1, Jefferson Davis Parish, Louisiana.



eliminate chain wear, and to rotate the pinion shaft in a manner that will not tend to displace it from its proper position. A small multi-cylinder variable cut-off engine, driving the table through at least a two speed gear box or transmission, seems to be the obviously proper rotary table prime mover. The engines may be vertical, horizontal or of the rotor type. A steam turbine may likewise be satisfactory for the purpose, though because of the turbine's requirements of excessive speed for high torque development the reciprocating engine is probably more satisfactory. Electric drive, with the proper type motor, is excellent. With variable cut-off reciprocating engines driving power pumps, and variable cut-off reciprocating engines driving the rotary table directly, steam consumption and consequent fuel savings of 45 to 50 percent are theoretically possible, and have been and are being definitely obtained.

Drilling Shaft

As stated in a previous paragraph the most delicate tool used in the boring of a hole is the drilling shaft which, in oil field practice, is composed of a kelly or grief stem, the drill pipe, and the bit or the cutting tool itself. The service rendered by the drill or bit collars and the kellys or grief stems seems to be satisfactory, providing they are built of good steels properly heat treated and accurately machined and balanced. Between these two is placed the drill pipe itself to which the tool joints are attached by a modified V-thread. The steel of the tubes, though undoubtedly subject to improvement, seems to give good service. The tool joints themselves, in so far as their pins and boxes are concerned are likewise adequate, but the method of attaching the tool joints to the drill pipe by means of the V-thread is not satisfactory and, if the great number of fishing jobs due to fatigue breaks in the threads of the drill pipe are to be decreased in number or eliminated, the thread form used in attaching the joint to the drill pipe must be changed. The change over to a satisfactory thread or method of attachment would cost the manufacturers, probably, to make a very wild guess, a few millions of dollars, but the fishing jobs due to these failures, together with the drill pipe that must be junked before the pipe itself has become fatigued beyond a useful limit, probably is as costly to the drilling industry each year as would be the entire change over to equipment for improved methods to the manufacturers of drill pipe and tool joints. It may be that drill pipe sizes should be altered slightly and lengths standardized; also the general form of the tool joint should be changed to increase its life and usefulness. For example, it would seem possible that a joint fully satisfactory for ordinary drilling could be so built that at the time the drill pipe had reached the end of its useful life as a component part of the drilling shaft or after it had given satisfactory service, it could be run into a well and cemented as casing, eliminating it thereby from the junk heap, and placing it in useful service. It is believed that this would be advantageous to the manufacturers of tubular goods and tool joints as well as to the operators.

Feed Controls

The conventional method of feeding the drill pipe into the hole, and the bit into the formation, is by use of the hand lever to release the pressure of the brake bands on the brake flanges, thus allowing the drum to feed off a desired quantity of line. This imparts an intermittent feed to the bit and if a certain weight on the cutting tool is proper, then this weight is only in use momentarily, as the bit is fed into the formation, from insufficient weight to excessive weight, and as it drills off from excessive weight to insufficient weight. In other words, the bit is drilling with the proper weight for a fractional part of the time only. Any boring tool, regardless of the medium being drilled, requires a steady pressure and a consequent even or smooth rate of feed. Obviously, then, some machine capable of feeding the bit into the formation smoothly is necessary, regardless of its type. Other points of advantage could be cited, but they are so obvious that they will not be discussed.

Unitization of Equipment

For purposes of economy in rigging up, the equipment should be unitized to within the maximum weights that can be handled with facility. On small rigs, three units plus the boiler plant, each boiler of which may be unitized, and the derrick tools are necessary. They are: the engine and draw works, the rotary table and drive, and the pumping plant. All the steam and water lines that can be should be put together with fast unions and cut in standardized lengths for any location.

Derrick Tools

Service from wire lines in use on deep holes is not satisfactory. Probably the sheaves are of insufficient size. It is doubtful that it is practically possible to place crown blocks and traveling blocks in service with sufficiently large sheaves, but certainly they may be increased over the present maximum 48-inch diameter. By increasing the width of the derrick floor and the water table two feet, adding an additional foot to each, the draw works side and the opposite side, at least 72-inch sheaves may be employed. Also, the additional floor space will better provide for pipe racks for the deep wells now being drilled and the deeper ones yet to be drilled.

Instruments

Fullest advantage of instrumental records of operations relating to the drilling of a well is not generally taken. There are available highly perfected instruments of many types in various lines of industry that can be readily adapted to oil field service.

During the past few years rigs directly powered by gasoline and Diesel engines and by alternating current motors have been developed. Prime movers of these types are satisfactory for simple operations but because of their power characteristics are not entirely satisfactory for general oil field drilling. An exception may be made in the case of the alternating current motors, which are being developed especially for oil field service into very satisfactory prime movers. Where current is taken from high tension lines continuous power must be certain.

Probably the best of the prime movers with the exception of steam is the direct current motor with current supplied by Diesel-electric generating units. The power characteristics of direct current motors are quite satisfactory in every respect, except for the more tedious pumping problems encountered in cementing jobs, fishing jobs, stuck drill pipe, and other special cases.

Summary

The most satisfactory source of power is steam and the most useful prime mover is the variable cut-off reciprocating multi-cylinder steam engine and the direct acting steam pump. It is most important now that steam generating units be improved and that more efficient prime movers be developed and, together with those which have been developed, placed in more general service. The draw works and hoisting system is in general need of reviewing and improvement. It may be possible that the present system involving the use of derricks, draw works, traveling blocks, and crown blocks is all wrong and could be changed for a more effective and economical system. It is without question that the present tools with which wells are being drilled are far from having reached their optimum efficiency, and the industry is greatly in need of improvements for the sake of drilling economy and safety.

Conclusions

It may be reasonably asked, why all of this fuss about improvements in drilling equipment? There are three logical replies to this: first, the improvement of things in daily use, regardless of what they may be, is at least the second law of nature; we always endeavor to reduce the time required to do a given job, in order that we may be free for something else, and to provide greater economy, in the broadest sense, in the operation. Second, the wells that are being drilled today are, in many and probably a great majority of cases, too costly, due primarily to inefficiency or weakness in the equipment used and the inexperience of the men using it. The equipment may be more readily improved than the experience and ability of the drilling crews. Third, the most difficult problems of the wells being drilled at the

(Continued on page 86)

Kirkuk No. 19 well showing arrangement of well head fittings and flow line.

IRAQ STABILIZATION PLANT

80,000 Bbl. Capacity

DURING 1936 the Iraq Petroleum Company, Ltd., erected and put into commission on their oilfield at Kirkuk a plant to stabilize that field's daily production of approximately 80,000 bbl. This plant is exceptional in that pressure crude direct from primary or first stage oil and gas separators is charged to the plant. After the elimination of the undesirable light fractions and hydrogen sulphide in the crude the treated oil is delivered to the tank farm at the first pump station.

Production of the Kirkuk field is carried to the Mediterranean through a double pipeline, of which one branch terminates at Tripoli, Lebanon, a distance of 532 miles, and the other at Haifa in Palestine, a distance of 620 miles. Owing to inadequate transport facilities between Kirkuk and the terminals, the bulk of the material required for the stabilization plant scheme had to be imported through Basra, the seaport of Iraq on the Persian Gulf, a distance of 560 miles from Kirkuk. This factor raised problems calling for special consideration in the matter of design and erection.

Existing facilities in the oilfield for water, electric power and housing for staff and labour were quite inadequate for a plant of this size. This made necessary the simultaneous installation of an electric power plant, a water pumping station on the Lesser Zab river and some 18 miles of water main with the construction of the stabilization unit. Tankage for water storage was erected and temporary accommodation built for housing the construction staff and labour. Erection of permanent bungalows for the operating staff and quarters for the labour was commenced at a later date and these are still under construction.

The stabilization scheme was authorized in May, 1935, and the first treated oil was delivered to the pipeline at the end of September, 1936.

An unusually wet winter hampered the erection work in the early stages and the large amount of labour required had to be secured from all parts of Iraq. The number of European and American specialists employed on plant erection reached 36 and the Iraqi overseers, artisans and labourers numbered some 1,600 at the peak period.

When the production scheme for Kirkuk field was being evolved the nature of the field indicated that central separator or degassing stations for groups of wells would be the most economical means of operation.

For such a scheme it was apparent that the crude as delivered to the first pipeline pumping station would be "wild."

Three separator or degassing stations are used, each equipped for two-stage, or, if required, single-stage separation. Wells have individual flow lines, sizes varying from four-inch to eight-inch, governed by length of line and/or volume required or available. The longest line is about two miles and the shortest about one-quarter mile.

Gas analyses at various pressures of separation were made as a guide to possible schemes of gas processing. In this it was realized that while normal methods would be satisfactory from a gas processing point of view, the distance of the field from seaboard precluded the possibility of a separate line, therefore recovered product must be returned to the crude, itself unstable, thus creating an unsatisfactory condition.

As the gas contains a fairly high percentage of hydrogen sulphide an investigation was started to ascertain the possibility of combining gas processing and H_2S elimination with the stabilizing of the total production.

At this stage Foster Wheeler Ltd., London, were approached and after some discussion the problem was placed in their hands for development. It was quickly recognized that the only possible means of eliminating undesirable gases and of retaining the valuable hydro-carbons was by efficient fractionation. Following a study of the gas analyses and other relevant factors, it was decided that crude at 50 lbs. pressure was the most desirable. At this pressure a butane recovery of approximately 75 percent of the total butane content of the reservoir crude can be obtained.

With a shade temperature differential between summer maximum and winter minimum of about 85° F. the gas content of the crude varies approximately as indicated in the accompanying table.

Gas Content of Iraq Crude

	Summer Tons per day	Winter Tons per day
Methane	8.4	10.4
Ethane	20.7	29.9
Hydrogen Sulphide	18.4	23.9
Propane	26.5	37.6
Iso-butane	25.6	28.1
Normal Butane	58.6	65.0
Iso-pentane	31.0	45.1
Normal Pentane	100.0	96.0
	289.2	336.0

It was necessary that inclusion of the stabilizing plant in the system between the field and the pipeline terminals must not jeopardize the full and continuous pumping capacity of the pipeline, whilst once the pipeline system had been flushed out with stabilized crude every effort should be made to prevent the necessity of unstabilized oil being allowed to enter it again since further cleaning out would be a lengthy process owing to its huge capacity.

The plant was designed in three units so that any two would be capable of handling the complete throughput of the pipeline with one always available as standby. As a further precaution against pipeline shut-downs, instead of following the practice of keeping each unit entirely separate, all corresponding equipment on each of the three units was interconnected in such a way that each item would be capable of immediate substitution by a corresponding item. Thus the first stage column on No. 1 unit is capable of being used with the remainder of the equipment on either units Nos. 2 or 3. Similarly the first stage column on unit No. 3 is capable of being used with the remainder of the equipment on either of units Nos. 1 or 2.

View of stabilization plant at night.

Each unit has the capacity to handle 40,000 bbl. of unstabilized crude oil daily and to produce therefrom a stabilized crude by elimination of hydrogen sulphide, methane, ethane, practically all of the propane and a proportion of the butanes.

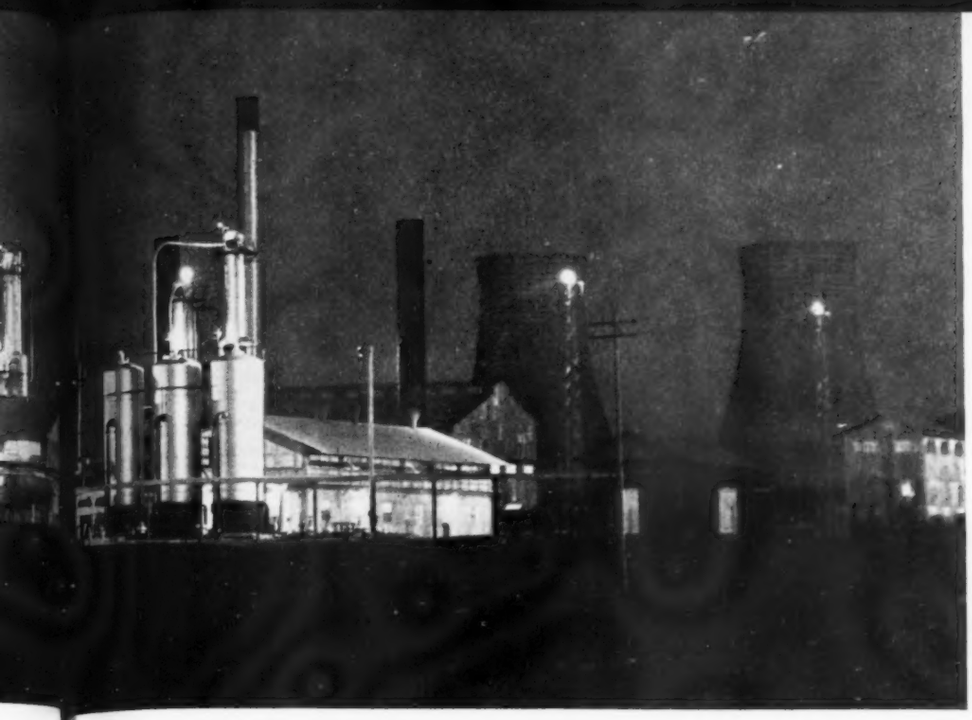
Operation of a single unit involves processing in two stages. Essentially, the first stage secures the elimination of undesirable constituents, effects a light topping of the crude and partial fractionation of the light distillate; the second stage fractionates the light distillate and vent gas from the first stage, and topped crude from the first stage is blended with stabilized distillate to produce the stabilized crude. The undesirable constituents in gaseous form are used as fuel and the excess led away to a safe point for burning.

In greater detail the operation is as follows: crude is delivered from the wells to the primary separator at the degassing stations; this separator is operated at a pressure sufficient to deliver the crude to secondary separators located near the process plant. Gas from the primary separators, which is not rich in gasoline, is led away and burnt. The secondary separators are operated at 50 lbs. per sq. in. A pressure-regulating valve on the incoming stream is set so as to prevent pressure dropping below 50 lbs. at any point between stages. The relatively small volume of gas taken off by the secondary separators enters the plant fuel system.

The three secondary separators are liquid level controlled and are ten feet in diameter and 32 feet high. From these pressure crude is picked up by the charging pump and delivered through a heat exchanger in which it is preheated by hot stabilized residue from the first stage column. From this heat exchanger the charge passes to a preflash column fitted with an automatic temperature controller and constant pressure regulator, ensuring a charge of constant composition to the plant proper by taking the crude oil of varying composition and subjecting it to venting under constant temperature and pressure conditions.

After leaving this column the charge is further heated in another first stage residue heat exchanger and is then flashed directly into the first stage stabilizing column which operates at approximately 100 lbs. per sq. in. pressure. Heat for operation of this column is supplied by a tube still serving as a reboiler, through which a portion of the residue leaving the base of the column is pumped, the return line from the tube still entering the column at a point below the bottom tray.

Stabilized residue from the base of this first stage column flows first through the tubes of the second column reboiler in which the necessary heat is abstracted for the operation of the second column. From the heating system of the second column reboiler the first stage residue flows through a heat exchanger in which the charging stock is preheated and thence through a cooler to an orifice mixer in which it is blended with the stabilized residue from the second column.



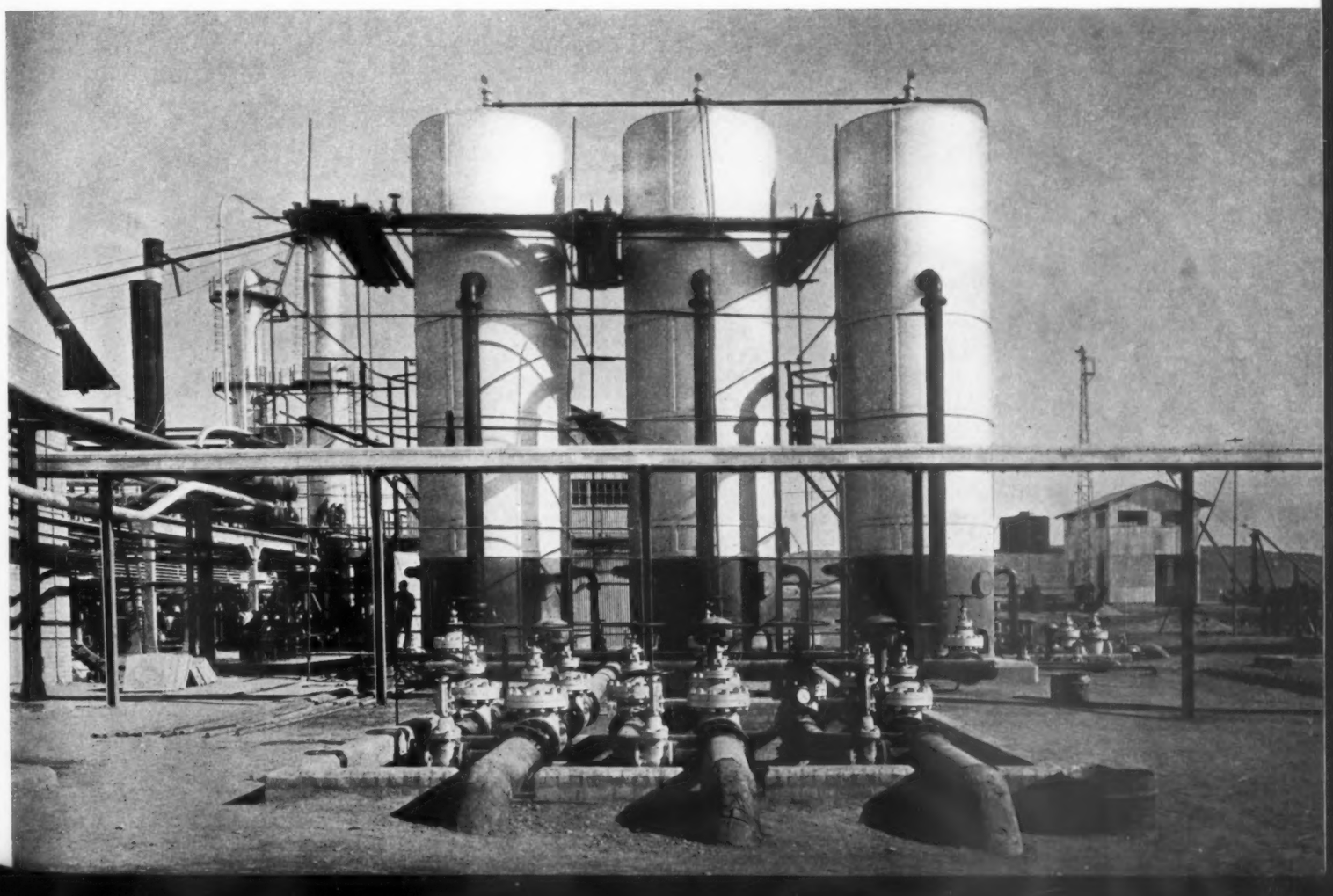
The vapours and non-condensable gases from the top of the first stage column flow to a vapour condenser and thence to a reflux accumulator from which the necessary amount of condensate is pumped back to the top of the column to serve as reflux.

Uncondensed vapours and non-condensable gases from the first stage reflux accumulator pass to a motor driven compressor and thence to the second stage stabilizing column which operates at a pressure of approximately 400 lbs. per sq. in. Such of the condensate from the first stage reflux accumulator as is not required as reflux, flows to a surge tank from which it is picked up by a distillate pump. This pump delivers it through a heat exchanger in which it is preheated by the hot stabilized residue from the second stage reboiler. The preheated condensate stream is then flashed directly into the second stage stabilizing column.

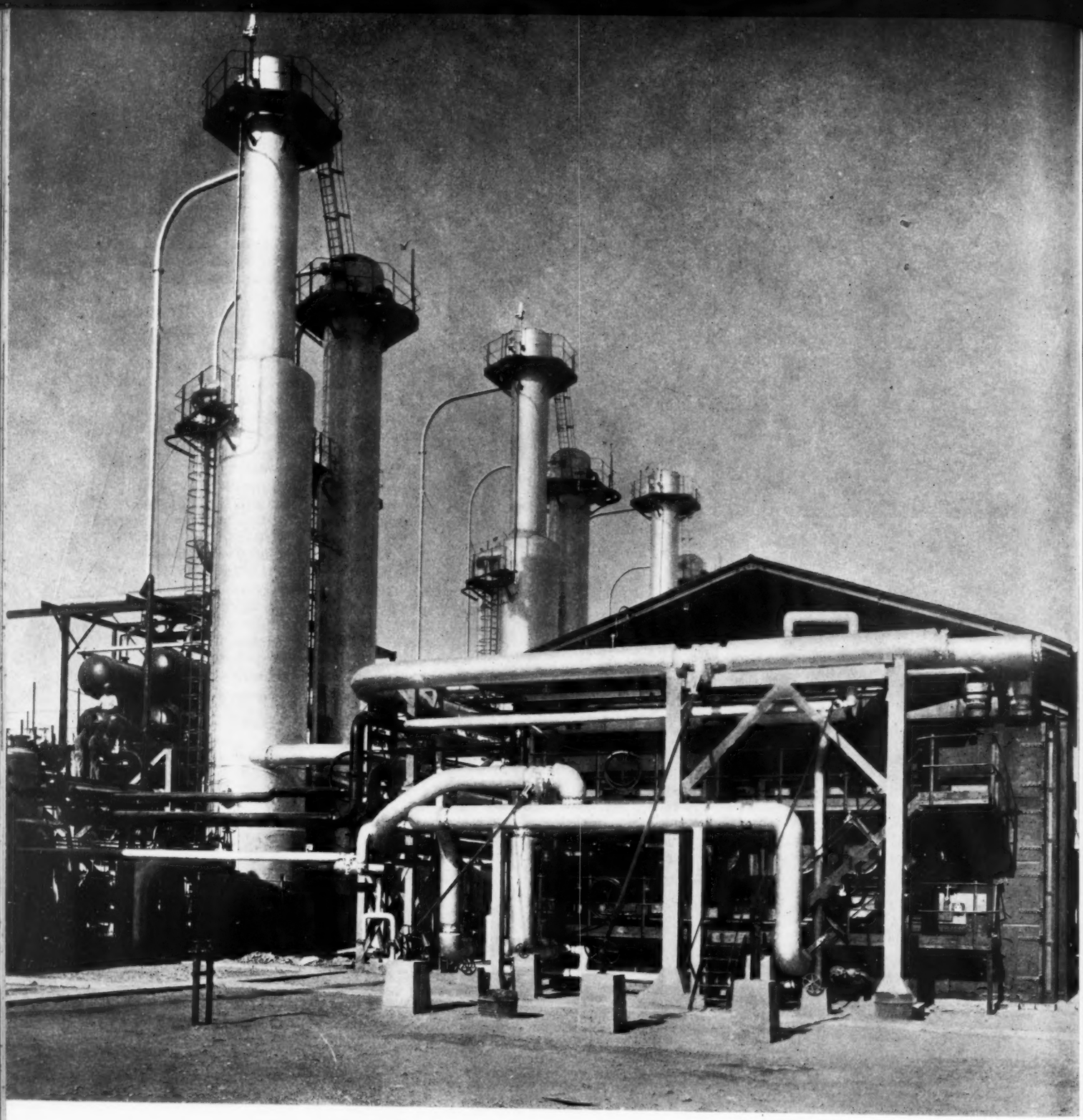
Vapours from the top of the second stage column flow to a vapour condenser from which the condensate and non-condensable gases pass to a reflux accumulator. The condensate is pumped back as liquid reflux to the top of the second stage stabilizing column and the non-condensable gases are vented from the system through a pressure relief valve set to maintain the requisite pressure on the second stage of the unit. The bottoms from the second stage column flow under pressure to the second stage reboiler which is heated by means of the first stage residue. The vapours from the reboiler are vented back to the base of the second stage column. From the reboiler the stabilized residue flows to the condensate heat exchanger and thence through a cooler to the orifice mixer for final blending back with the first stage residue.

The stabilized crude oil thus produced flows under plant pressure to the first pumping station on the trans-desert pipeline. It is interesting to note that stabilization of the crude is carried out in the absence of either water or steam, thus avoiding corrosion of the plant due to the sulphuretted hydrogen.

The contract for the supply and erection of the oil processing plant was placed with Foster Wheeler Ltd., London, England, and that for the necessary power station and boiler plant with the Spearing Boiler Co. Ltd. of that city. The contract for the erection of the Nouchel reinforced concrete water cooling towers was awarded to J. C. Gammon Ltd., Bombay, together with the foundations for the process and power plants.



Secondary separators. The incoming pressure crude lines and regulators are in the foreground; foamite generator house on right.



View of process plant showing condensers, columns and tube stills.

Iraq Petroleum Company Ltd. set about the preparation of the sites, the building of temporary accommodation, oil lines to and from the plant, a water pump station, the laying of an 18-mile line for water from the Lesser Zab river and various ancillary works.

The contract for the supply and erection of two steel tanks for water storage was given to the Whessoe Foundry and Engineering Co. Ltd., Darlington, England.

The tube stills are of latest Foster Wheeler double-end fired all-radiant type having the heating surfaces located in a single row in the roof, on the floor and on the two side walls of the heater. The heat liberation in each tube still is approximately 120,000,000 B.T.U. per hour. The heating surface consists of six-inch o.d. bare seamless steel tubes each with an effective length of 30 feet. The roofs are of Detrick suspended firebrick flat arch type and the settings of the suspended air cooled type finished off with Transite sheeting. Peabody combination gas and oil burners are employed for firing the tube stills. The three stacks, one serving each tube still, are of the self-supporting type fabricated of mild steel and lined with firebrick. Each stack is approximately 90 feet high and is connected to the tube stills by underground brick flues.

The preflash columns are five feet nine inches diameter by approximately 20 feet high and are designed for a working pressure of 150 lbs. per sq. in. The first stage stabilizing columns are about 70 feet high, have a diameter of four feet six inches in the upper section and eight feet in the lower section, and are designed for an operating pressure of 100 lbs. per sq. in. The second stage stabilizing columns, designed for a working pressure of 400 lbs. per sq. in. are approximately five feet three inches in diameter by 68 feet long, and are fabricated of 1⅜-inch mild steel plate, class 1 fusion welded and X-rayed after welding.

The heat exchangers, condensers and coolers are of Foster Wheeler shell and tube floating head type with removable tube bundles. They are made up of about 43 miles of one-inch tubes and have a surface of approximately 60,000 square feet. All tubing is standardized at 14-foot lengths to reduce the number of spare tubes to be carried in stock.

All condensers and coolers are tubed in tinned Admiralty metal and all heat exchangers in steel. The diameters of the shells vary from 42 inches to 10 inches, three sizes only being employed. The second stage reboilers are of the tank type, suitably baffled and fitted with heating surface in the form of a removable tube bundle with floating head.

The compressors are of the balanced opposed type having horizontal twin cylinders. They have been designed and supplied by Clark Bros. Co., United States. Drive is by means of Mather & Platt revolving field salient pole synchronous type motors running at 250 r.p.m. and developing 225 B.H.P. on a 3,300-volt 50-cycle 3-phase supply. They are designed to operate with a 0.9 leading power factor and are used for correcting the power factor of the system. These motors with their direct coupled exciters are arranged in a room containing the switchgear and motor starters and drive the compressors by means of jackshafts through a fire wall. The motors are arranged for auto transformer starting and the starting current is less than twice full load current.

Process pumps are of Mather & Platt design and manufacture, all of "Plurovane" multi-stage turbine type running at speeds of approximately 975 and 1,450 r.p.m. Drive to the pumps is carried through wall boxes in a partition wall to Mather & Platt screen protected squirrel cage rotor induction type electric motors.

The duties of these pumps are extremely severe. The hot oil pumps, for example, have to pump oil at a temperature up to 520° F. at a pressure of 150 lbs., the quantity of oil being 1,320 gallons per minute. The second stage column reflux pumps handle what is essentially liquid propane at pressures up to 450 lbs. per sq. in.

Controlling and recording of plant operations is automatic as far as possible. Recording temperature controllers are installed at the base of the preflash columns, and at the top of the first stage stabilizing columns, and on the inlet and outlet of the second stage reboilers. Indicating temperature controllers control the first stage reflux supply; the first stage column inlet, tube still inlet and outlet temperatures are recorded. Pressure controllers are installed on all columns and reflux accumulators. The flow of liquid from the base of all columns is controlled by liquid level controllers. Pumps are equipped with indicating or recording flow controllers; ratio flow controllers in the compressor suction lines ensure equal flow to the two second stage columns in normal operation. In addition there are numerous pressure gauges and thermometers.

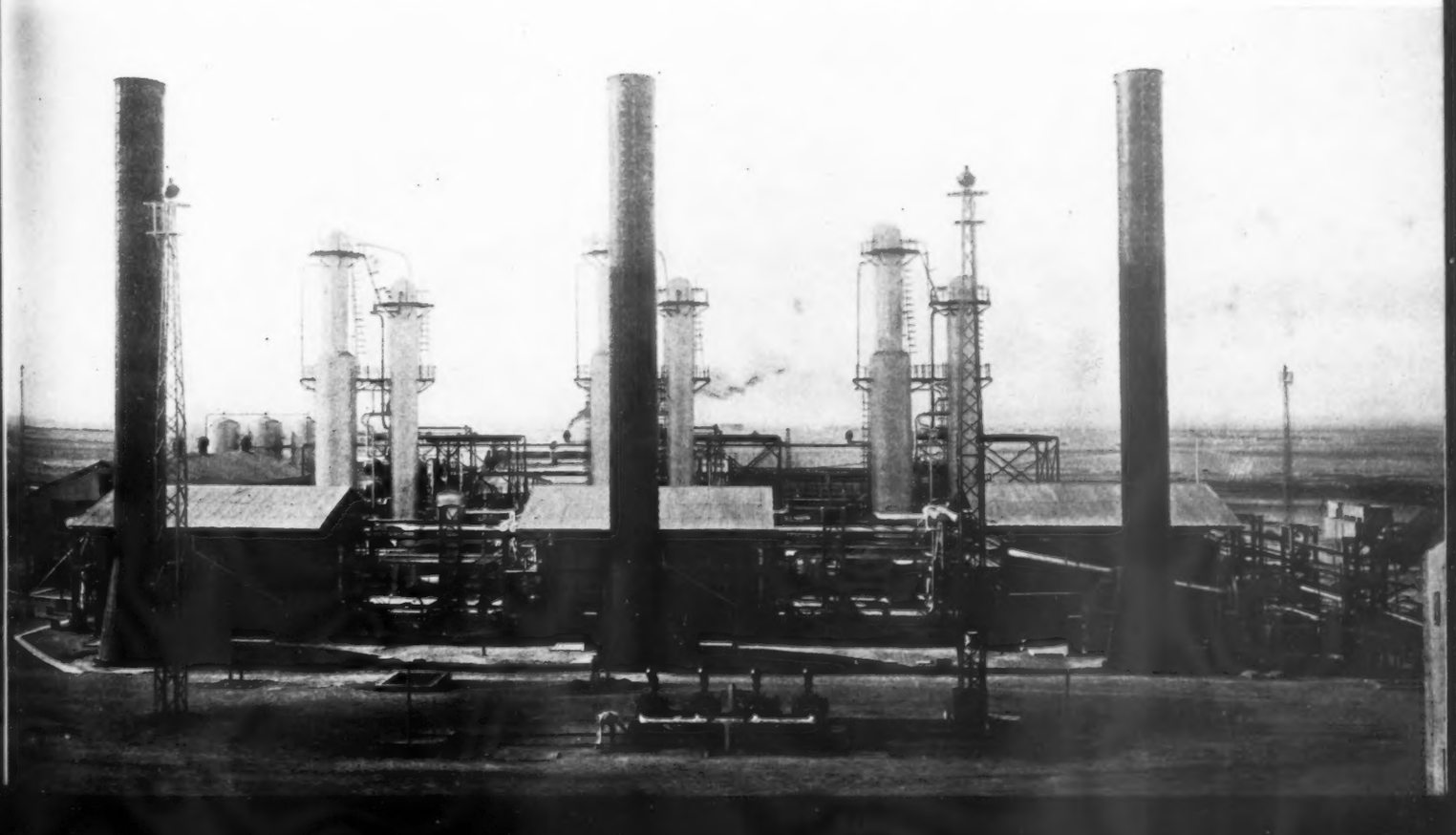
Temperature, pressure recorders, controllers, and instrument panel have been supplied by George Kent Ltd., and liquid level controllers by the Fisher Governor Company. The instrument panel is over 30 feet long and carries 24 measuring and controlling instruments together with all signal lights, piping and wiring appertaining thereto. Cabling within the process plant for power, light and instruments amounts to approximately 12 miles in length. All circuits to motors and light points are duplicated to minimize shut-downs.

Electric welding was used for the pipe work, 85 percent of which was fabricated at site. All oil process valves and imported fabricated manifold piping were supplied by the Crane Co., Chicago. Cooling water for circulation within the process plant under normal operation totals from 4,500 to 5,000 gallons per minute, and the consumption of electric power is about 750 k.w. As a further indication of the size of the process plant it may be stated that the total weight of the equipment is approximately 3,000 tons and the length of piping within the battery limits about 11 miles.

The boiler plant consists of two Spearing water-tube boilers each being capable of evaporating continuously under natural draught conditions 36,000 lbs. of steam per hour from feed at 120° F. The working pressure is 200 lbs. per sq. in. and the final steam temperature at the superheater outlet 550° F. The superheaters are integral parts of the boilers.

The power station equipment consists of two British Thompson-Houston turbo-alternator sets, each set being rated at 2,000 k.w. maximum and 0.8 power factor, together with the condensing plant and auxiliary equipment. The electric supply is generated at 3,300 volts, 3-phase, 50-cycles. The tur-

General view of process plant showing the three units; temporary fire pumps in foreground. Columns are arranged in each unit: 1st stage on left, 2nd stage in center, preflash on right.



bines are direct coupled to the alternators and are designed to operate at 3,000 r.p.m.

Power is distributed to the process plant at 3,300 volts and 380 volts, the latter voltage being obtained by means of suitable step-down transformer sub-stations. The power to the Lesser Zab water pumping station and other distant points of consumption is transmitted at 22,000 volts by means of suitable step-up transformer sub-stations.

The necessary cooling water for the turbine equipment and the process plant is cooled by passage through two Mouchel type 38 hyperbolic concrete cooling towers. Each tower is designed to deal with 360,000 gallons of water per hour, to be cooled from 122° F. to 90° F. under an atmospheric wet bulb of 80° F. under natural draught. The diameter of the towers at the base of the column is 87 ft. 2 in. and the height 112 ft. 9 in.

Circulation of the cooling water through the process plant is obtained by means of two 16-inch "Medivane" centrifugal pumps each driven through gears by single stage impulse type steam turbines, manufactured by Mather & Platt Ltd. Each pumping set has a capacity of 8,000 gallons per minute against a head of 121 feet.

The Lesser Zab station, which is about 18 miles from the plant, provides the water for the stabilization plant and general field uses. The river carries down large amounts of silt during the rainy season and, in order to obtain a clear water at all times of the year, water is drawn from wells sunk in the gravel banks of the river. The well pumps discharge into a balance tank and the water is picked up from this tank by the main pumps. All the pumps are electrically driven, the power transmitted from the power plant by means of an overhead line at 22,000 volts being transformed down to 380 volts at the pump station.

Each borehole pump is capable of pumping 350 gallons per minute against a total head of 60 feet and is driven by a vertical spindle squirrel cage induction motor. These centrifugal pumps are designed to enable them to be moved from one well to another without difficulty.

The main pumps consist of three Mather & Platt "Plurovane" pumps each capable of delivering 750,000 gallons per day against a total head of 887 feet. The water is delivered to a 2,250,000 gallon steel main storage tank at the stabilization plant site through a 12-inch welded steel main. The main storage tank is sited so that water flows to the plant by gravity, whilst water for the remainder of the field is pumped from the plant to a one-million-gallon steel storage tank. Water from this second tank can gravitate back to the main tank in case of emergency.

The plant has been well provided with fire fighting equipment, two main systems being employed,—the "Duomixer Foamite" system and the "Mulsifyre" fire protection equipment: the former follows usual practice; the latter is an additional protection for combating possible fires in the manifold pits and pump rooms, also serving as a means for protecting the pipework in these localities by drenching them in water. Ample steam and water jets have been provided throughout the plant.

In conclusion the stabilization plant scheme will provide the refineries handling Iraq crude with an oil richer in valuable light fractions, and less liable to cause corrosion to plant or equipment, or pollution of the atmosphere.

Ferry on Lesser Zab river in Iraq. Water from this river is pumped 18 miles to the new sterilization plant at Kirkuk.

BRITISH

Imports Reach New Record of 83,649,371 Bbl.

IMPORTS of petroleum into Great Britain set up a new record in 1936 with a total of 83,649,371 barrels. This represents an increase of 4.8 percent on 1935 and 6.4 percent on 1934. Continued activity in import business reflects further improvement in Britain's internal trade, in addition to the increasing use of petroleum products in motor transport and general industry.

Expanding industrial activity is the evident explanation of the advance in inward shipments of lubricating oil, which, in spite of the expansion of lube refining facilities within Britain, rose by 14.4 percent last year against 1935. That industry is using more lubricating oil is revealed by a comparison of the lubricating and motor spirit import statistics. Motor spirit imports increased in 1936 by 3.4 percent, a rise which corresponds exactly with the percentage advance in Customs releases of motor spirit for home consumption during the first ten months of the year. With cars using only 3.4 percent more spirit, a rise during the year of as much as 14.4 percent in lubricating oil must be due to increasing use of that product in industrial machinery.

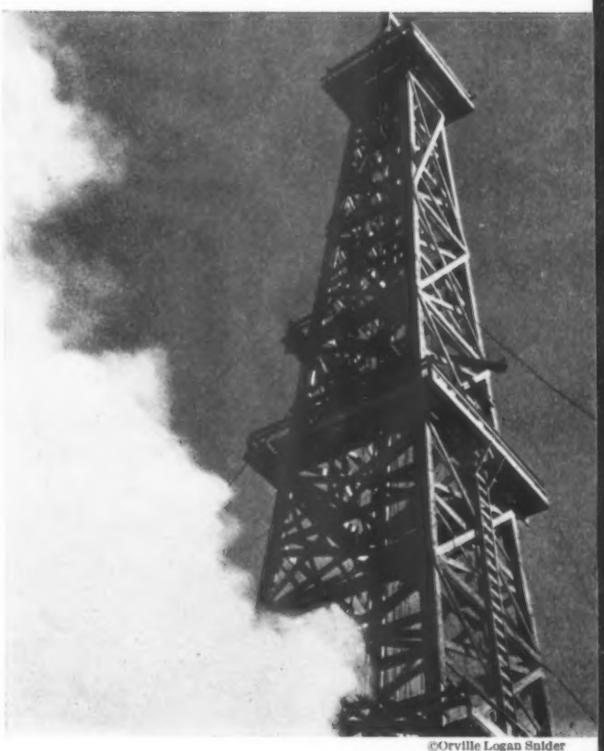
Total British imports of all refined products last year show a percentage rise of 4.8, which compares with an advance of 5 percent in Customs releases of refined petroleum during the January-October period of 1936. Crude oil imports for the year expanded by the same percentage as refined, indicating that British refineries continued to treat very much the same proportion of total consumption as in 1935. This deduction, however, is subject to possible variations in stocks and to changes in the amount of imported products subjected to further treatment in Britain.

Analysis of the imports received from various exporting countries shows that the whole of the rise in Britain's receipts can be accounted for by the higher shipments from the Netherlands West Indies. Total receipts from this quarter amounted to 29,955,628 barrels, compared with 25,682,000 barrels in 1935, and represents approximately 36 percent of the year's total imports from all countries. The Netherlands West Indies is thus more firmly established than ever as the predominant supplier of the British market, mainly as a result of the shipping policy adopted in recent years by the Standard of New Jersey and the Royal Dutch-Shell groups.

Relative positions of the other major exporting countries were maintained in the British market. Iran stands second to the Netherlands West Indies as an exporter to Britain with a total of crude and products of 15,564,428 barrels, the United States maintaining third place with an aggregate of 8,396,971 barrels. The U.S.A., however, further increased its importance as a shipper of lubricating oil, the total of this product from America being 2,159,600 barrels.

Indications of higher import prices, furnished by the course of recently published c.i.f. values, are borne out by the import value figures in the accompanying table. While the total volume of all refined products imported was 4.8 percent higher last year than in 1935, values increased by 12.1 percent, revealing a substantial increase in the unit value of the products imported.

Average values of kerosene imported are shown to have been lower in 1936 than in the previous year, a rise of 11.6 percent in volume being accompanied by an increase in value of only 6.9 percent. Selling prices of kerosene have been increased by ½d. per gallon since the beginning of the current year, but this movement is explained by the fact that although import prices declined in 1936, selling prices in Britain were still unduly low.



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Justification for the recent advance of ½d. per gallon in British motor spirit prices is provided by the higher unit value of spirit imported last year. Total motor spirit imports increased by 3.4 percent, but their value was 11.0 percent above that for 1935. In view of the improvement in the United States oil position, and higher import values, the rise in the retail selling price had been confidently expected in Great Britain. The rise which has been announced is regarded as a means of testing the market, and if reactions are favorable, and the business of established companies is not unduly disturbed by outside distributors, a further advance in the price is considered possible within the next few months.

Until January, British motor spirit prices had remained unaltered since May 1, 1935, when first grade spirit was increased 1d. per gallon to 1s. 6d. As the current price of 1s. 6½d. per gallon includes 8d. tax, it leaves only 10½d. per gallon to cover original cost, transport, refining and distribution, even in transactions where the

BRITISH OIL IMPORTS

	Quantity 1936 Bbl.	Percentage rise on 1935	Value 1936 £	Percentage rise on 1935
Kerosene	6,121,057	11.6	2,461,164	6.9
Motor spirit	36,377,000	3.4	19,982,273	11.0
Lubricating	3,378,343	14.4	4,079,147	23.4
Gas oil	3,191,086	3.6	1,091,426	4.9
Fuel oil	19,403,771	3.6	5,084,083	12.6
Other sorts	553,400	16.7	291,823	11.7
Total products	69,024,657	4.8	32,989,916	12.1
Crude	14,624,714	4.8	4,201,731	1.5
Total imports	83,649,371	4.8	37,191,647	10.8

full price of first grade spirit is obtained. In practice, a very large proportion of the spirit sold in Britain is disposed of under conditions leaving the companies with a price far below the fixed price of the product, and a further large part of total sales consists of commercial grades traded on an altogether lower price basis.

An aspect of the rise in motor spirit prices which has received considerable attention from British observers is the coming British Budget. It is common knowledge that there will be a drive for further tax revenue at the end of the current financial year on March 31, and it has been suggested that a higher selling price now may be regarded as a possible protection against any further increase in the "petrol tax." Comment on these lines is doubtless due to the remembrance of an occasion when a reduction in motor spirit prices was followed almost immediately by an equivalent increase in motor spirit taxation, the net result being that the Chancellor of the Exchequer was richer, the oil companies poorer, and the British motorist just where he was before.

As usual when a rise in motor spirit prices is announced, attention has been drawn by quarters connected with British motoring to the additional burden imposed on the motoring public by higher fuel costs. Criticism on these lines has been less pronounced on the occasion of the latest advance in motor spirit prices, owing no doubt to the justification for higher prices. Increased costs of imported spirit, with the general rise in commodity prices and the upward trend of distributing costs, provide reasons for the higher price which the severest critics could not ignore.

WASHINGTON

Considers Large Number of Oil Bills

WASHINGTON—FEBRUARY 1

REGULATION of interstate commerce in gas as well as oil bade fair to become paramount issues of the moment in Congress as February opened.

Extension of the Connally hot oil law, prohibiting the movement between the states or to export ports of petroleum produced in excess of state orders, was first on the official calendar for action.

But along with this bill there were others in the offing that would affect the petroleum industry at home, and, to some extent, abroad, although they were not as spectacular as the Connally Act question.

First, Representative Clarence Lea of California, now Chairman of the House Interstate Commerce Committee, was ready with a bill to regulate interstate commerce in gas and invade a field heretofore free of federal regulation. The Lea bill as it will be introduced, will be about the same as the measure of last year. The strategy will be to tack it onto the Connally Act as it comes through.

Wrapped up in the legislative paper of Committee consideration and action was another bill of considerable importance to all industry as well as to oil, the O'Mahoney licensing bill. This proposal, which Democratic Senator O'Mahoney put forward in the Senate last year, has a better chance this year, but only if President Roosevelt indicates his approval. The best inside story is that Mr. Roosevelt is not so sure yet that he wants to do that.

Familiar bills held over from previous sessions were on hand as usual, including the bill of Representative Boland of Pennsylvania to put a cent a gallon tax on all fuel oil. This bill was referred to the House Committee on Ways and Means, to rest alongside another tax bill by Morgan Sanders of Texas, proposing to double the excise taxes on imports and remove bunkering supplies from the free list.

Neither is likely to get anywhere in the final roll calling, although there is an outside chance that the lobby fighting for the Sanders bill might wangle it through. Sanders personally probably isn't too much interested in its welfare and, unless adequately supported by colleagues from producing states, will not be able to get it out of Committee.

Hearings on the Connally hot oil law were due to begin on February 12, with the Senate Finance Committee delegating the task to a subcommittee headed up by the author, Senator Tom Connally of Texas. Secretary of the Interior Harold L. Ickes will be the first to be heard and his approval is a foregone conclusion. After that, several dozen others will express their views.

The opposition to the bill is being led by Paul Hadlick of Washington, secretary of The National Oil Marketers Association, who, with his members, contends that it destroys a free source of supplies and thus works to create a monopoly. Whether Hadlick can get anywhere with his arguments is doubtful. The chances are that he will not, even though some of his jobber members are putting out information privately to support the contention that regulation permits the integrated companies to run the independents out of business.

Preservation of the oil reserves was a question raised as January drew to a close in bills by Senator David I. Walsh of Massachusetts. One of the Walsh bills might be important if it shows any signs of being enacted: Senate Bill 1131, providing for the termination of existing private contracts in naval reserves, and extending this to oil shale deposits, along with prohibiting leasing to other than domestic owned companies or domestic operators, except where reciprocal privileges were granted by their governments.

"The conservation of these reserves is one of our most important national defense problems," Walsh said. "At the present time practically all vessels of the American Navy burn oil and no coal-burning vessel can compete with them in maneuverability. Unless these reserves are maintained, it is possible that the activity of the fleet in time of national emergency may be reduced."

Price discrimination bills and chain store bills by the dozens were in the hands of various committees, virtually all due to gather dust and death. One remained likely of passage, a new Patman-Robinson Act, considerably strengthening and tightening up the prevailing law.

Along the Administrative avenue, January was fairly quiet. The Federal Trade Commission cleared the way to do something about the Marketing Code, moving to cancel the old 1931 code. The action came in asking companies to express any views toward a proposal by the Federal Trade Commission to cancel the code. None is expected, except for approval. The next order will then be a hearing to see if it should be cancelled. When that is done, the Commission will undertake to pass on the code prepared under the general guidance of Charles E. Arnott, B. L. Majewski, Wilmer Schuh and Paul Hadlick.

Secretary Ickes, except for writing Senator Connally his approval of the Connally Act being made permanent, was pretty quiet. The story is that he is waiting for the day when he becomes Secretary of Conservation in the Roosevelt Cabinet, after which he will go into the question of regulating natural resources.

In the move for this new department, which will be, really, a complete reorganization of the Interior Department, the Administration probably will include its coordinated conservation program for all natural resource industries. The only question involved is when the move will be made—not whether it is to be made.

The inauguration and floods, between them, gave Washington a quiet January from the government's headquarters. These two events kept Congressional plans in the doldrums, generally. The members were just beginning to settle down as the month ended.

Foreign Oil Legion

J. A. de Lanoy

J. A. DE LANOY, Chief Purchasing Agent for Asiatic Petroleum Corp. and Anglo-Mexican Petroleum Corp., has been appointed to Knighthood in the Order of Orange Nassau by Her Majesty Queen Wilhelmina. The bestowal of this unusual honor at a meeting of the Netherlands Club in New York on the 22nd of January came as a complete surprise to Mr. de Lanoy, who is president of the club. After a dinner which preceded the meeting, Her Majesty's Ambassador at Washington, Jhr. Haersma de With, conferred the decoration "for promotion of friendly relations between the United States and The Netherlands".

Eugene Holman

M. J. Trees, vice president and sales manager of Chicago Bridge & Iron works sailed the latter part of February from New York for a general business trip through England, France and Italy.

Morgan Walker, extreme right

EUGENE HOLMAN, president of Lago Petroleum Corp. and Creole Petroleum Corp., accompanied by Morgan Walker, chief engineer of Jersey Standard's producing department, left Miami January 23rd via Pan-American Airways for Maracaibo on an inspection trip of their properties in Venezuela. They are expected to return to New York toward the end of February. Mr. Walker succeeded W. R. Finney in July, 1936, when Mr. Finney became president of Oklahoma Pipe Line Co. and Ajax Pipe Line.

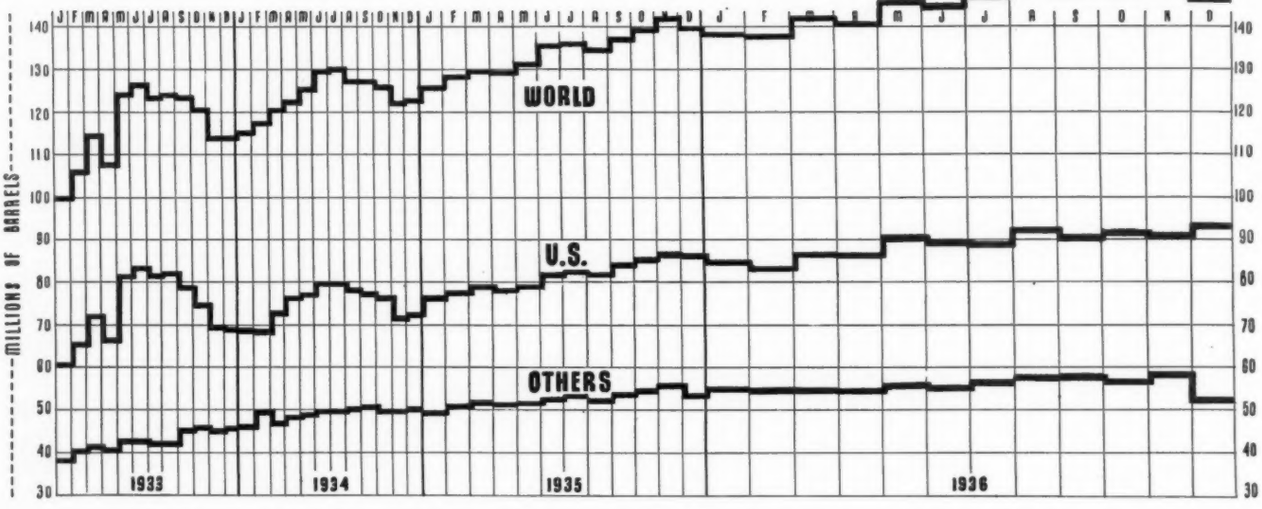
DR. L. MINTROP, Professor of Geophysics in the University of Breslau, Germany, sailed from New York, February 9, on the EUROPA after a stay of several weeks in the United States. Prof. Mintrop has attained high distinction as a seismologist and geophysicist.

Dr. Mintrop's visit to America was made in connection with a suit brought by The Texas Company for infringement of the Mintrop and McCollum patents which it holds. The suit, however, was settled out of court. It is understood that each of the primary group of major companies who participated in the defence is acquiring a release and license from The Texas Company and that releases and licenses on the same terms, that is $10,000 per seismograph party, are being offered to the numerous members of the secondary group. Several of the large companies are acquiring unlimited licenses (limited to their own use) by making a total payment of $125,000. Licenses are also available outside the United States for $1,000 per party per month in Netherland Colonies and $500 per party per month elsewhere except Germany.

WORLD CRUDE PRODUCTION FOR 1936

Totals 1,780,820,035 Bbl.

All Producing Areas of World Show Increase Over 1935 Figure Except Poland, Brunei and Sarawak. U. S. Production Up 103,319,150 Bbl.—Russia Up 15,223,100 Bbl. Curtailed December Production in Venezuela Limits That Country's Gain to 5,883,927 Bbl.



World crude oil production by months, 1933–1936. Chart is weighted to compensate for variation in number of days per month. Ratio of U.S. crude production to world production.

World Oil Production—Official Figures for 1936

All figures furnished direct to WORLD PETROLEUM by governments, except where otherwise specified.

(Figures in U.S. Barrels—Conversion ratio 7 bbl.=1 ton)

Country	January 1936	February 1936	March 1936	April 1936	May 1936	June 1936	July 1936	August 1936	September 1936	October 1936	November 1936	Provisional Figures December 1936
United States	88,820,000	82,120,000	90,568,000	90,479,000	93,739,000	90,185,000	92,078,000	95,090,000	90,972,000	95,795,000	91,018,000	96,397,150
Russia	16,155,300	15,288,700	16,344,300	15,589,000	16,454,200	15,955,100	16,231,600	15,737,500	14,936,600	16,118,900	16,700,000[1]	16,400,000
Venezuela	13,487,089	12,849,480	13,432,671	13,442,870	13,732,933	12,486,600	14,566,510	14,632,737	14,626,073	13,888,287	14,307,650	8,452,625
Roumania	5,242,000	4,809,000	5,209,000	5,226,000	5,568,000	5,563,000	5,606,000	5,585,000	5,254,000	5,224,000	4,982,000	5,050,000
Iran[2]	4,627,000	4,480,000	4,641,000	4,312,000	5,376,000	5,061,000	4,872,000	5,117,000	4,487,000	4,704,000	4,620,000	4,963,441
Netherland India	3,614,436	3,407,194	3,670,877	3,532,375	3,721,613	3,549,417	3,725,491	3,715,887	3,731,973	4,059,426	4,139,954	3,794,214
Mexico	3,377,302	3,285,965	3,542,088	2,997,883	3,235,255	3,167,300	3,179,614	3,773,503	3,768,855	3,235,224	3,204,007	4,259,728
Iraq	2,327,332	2,107,210	2,515,345	2,048,053	2,467,136	2,473,660	2,440,669	2,479,428	1,881,782	2,097,564	2,214,954	2,207,954
Colombia[3]	1,611,618	1,475,403	1,619,620	1,427,193	1,598,544	1,529,901	1,585,345	1,553,606	1,575,273	1,600,288	1,537,683	1,641,636
Peru[4]	1,377,006	1,293,627	1,351,810	1,403,626	1,500,485	1,452,306	1,524,303	1,527,072	1,478,482	1,507,433	1,445,605	1,492,023
Argentina	1,310,129	1,273,243	1,366,691	1,260,277	1,231,354	1,140,080	1,286,536	1,293,283	1,323,730	1,283,927[1]	1,310,000[1]	1,472,748
Trinidad	1,079,082	983,424	1,081,191	1,026,423	1,066,728	1,078,186	1,121,583	1,108,969	1,126,420	1,179,611	1,154,093	1,231,365
British India	854,644	756,384	791,162	790,376	827,762	778,947	817,364	815,415	791,217	660,000[1]	658,000[1]	765,576
Poland	338,800	323,400	338,800	323,400	331,100	287,000	294,000	301,000	294,000	301,000	294,000	301,000
Brunei	253,400	237,930	257,250	270,900	225,890	206,780	266,700	275,310	257,040	294,070	294,560	322,210
Germany	254,492	227,444	274,393	246,519	244,552	256,613	272,699	257,859	255,556	277,158	265,650	279,565
Japan	183,651	165,877	196,569	194,167	203,071	198,387	206,284	221,139	207,260	200,528	202,385	205,060
Ecuador	148,980	138,721	162,125	159,666	163,855	156,703	163,714	160,914	158,857	168,892	163,870	175,918
Sarawak	139,300	127,050	136,290	130,900	134,610	128,660	130,200	129,150	122,010	127,330	122,920	128,240
Canada[5]	121,231	107,928	117,824	107,748	114,297	114,050	139,940	139,789	135,624	142,504	129,152	137,454
Egypt	91,497	97,573	111,846	101,038	107,989	106,694	106,260	102,620	98,812	102,109	97,755	98,672
France[1]	44,981	42,079	44,981	43,530	44,981	43,530	44,981	45,000	45,000	45,000	45,000	45,000
Bahrein[1]	300,000	300,000	300,000	300,000	360,000	360,000	360,000	360,000	372,000	372,000	372,000	372,000
Others[1]	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total	145,834,270	135,972,632	148,148,833	145,487,944	152,514,355	146,353,914	151,094,793	154,497,181	147,974,564	153,459,251	149,354,238	150,268,560

[1] Estimate. [2] Anglo-Iranian Oil Co. figures revised; fuel oil returned to the ground has been deducted. [3] International Petroleum Company's figures. [4] International Petroleum Company and Lobitos Oilfields Ltd. figures. [5] Includes natural gasoline production.
Russian Sakhalin included with Russia. Japanese Sakhalin included with Japan.

Official Crude Oil Production 1932 to 1936

	Daily Average 1936	Daily Average 1935	Daily Average 1934	Daily Average 1933	Daily Average 1932	Total 1936	Total 1935	Total 1934	Total 1933	Total 1932
United States	2,997,981	2,723,129	2,490,704	2,462,670	2,145,243	1,097,261,150	993,942,000	909,107,000	898,874,000	785,159,000
Russia	524,348	469,608	462,051	407,950	409,070	191,911,200	176,688,100	168,648,700	149,901,900	149,719,000
Venezuela	436,900	421,977	385,712	331,186	326,766	159,905,526	154,021,599	140,784,805	120,882,802	119,596,512
Roumania	173,000	167,534	169,879	139,647	137,954	63,318,000	61,150,000	62,006,000	50,971,200	50,491,205
Iran	156,449	143,600	144,284	135,840	123,285	57,260,441	52,413,879	52,663,782	48,581,280	45,122,455
Netherland India	122,030	116,629	115,861	105,516	108,153	44,662,857	42,569,625	42,289,408	38,512,663	39,584,027
Mexico	112,095	110,233	104,567	92,890	89,624	41,026,724	40,234,902	38,167,022	33,904,882	32,802,285
Iraq	74,484	68,085	21,742	3,288	3,300	27,261,087	24,850,924	7,935,657	1,200,000	1,200,000
Colombia	51,246	48,268	47,509	36,047	44,768	18,756,110	17,617,654	17,340,724	13,157,127	16,834,956
Peru	47,415	46,270	43,663	38,146	26,026	17,353,778	16,835,206	15,936,937	13,923,281	9,899,266
Argentina	42,492	39,226	39,015	38,232	35,975	15,551,998	14,317,500	14,045,652	13,759,565	13,166,900
Trinidad	36,167	31,686	29,847	26,192	27,387	13,237,075	11,669,792	10,894,363	9,560,039	10,023,780
British India	25,429	25,281	24,650	23,893	23,500	9,306,847	9,227,496	8,997,399	8,721,655	8,600,312
Poland	9,773	9,896	10,130	10,570	10,670	3,577,000	3,612,000	3,697,617	3,858,085	3,905,230
Brunei	8,639	8,647	7,323			3,162,040	3,162,614	2,673,041		
Germany	8,504	8,409	6,211	4,692	4,983	3,112,480	3,054,023	2,266,964	1,712,823	1,824,019
Japan	6,515	5,065	4,068	3,827	4,375	2,384,378	1,848,656	1,484,962	1,337,761	1,575,333
Ecuador	5,252	4,727	4,534	4,446	4,300	1,922,215	1,725,354	1,655,062	1,622,624	1,573,857
Sarawak	4,253	5,002	5,337	6,273	6,213	1,556,660	1,811,297	1,948,044	2,289,472	2,274,043
Canada	4,119	3,965	3,898	3,185	2,854	1,507,541	1,447,204	1,422,869	1,162,541	1,044,412
Egypt	3,341	3,330	4,052	4,360	4,760	1,222,865	1,215,606	1,479,037	1,591,495	1,742,370
France	1,459	1,451	1,512	1,515	1,508	534,063	529,664	552,000	552,000	552,000
Bahrein	11,279	3,465	781			4,128,000	1,264,809	285,071		
Others	2,459	2,470	2,359	1,184	1,180	900,000	900,000	861,000	432,000	432,000
	4,865,629	4,467,953	4,129,689	3,884,063	3,544,914	1,780,820,035	1,636,109,904	1,507,143,116	1,417,549,195	1,296,672,962

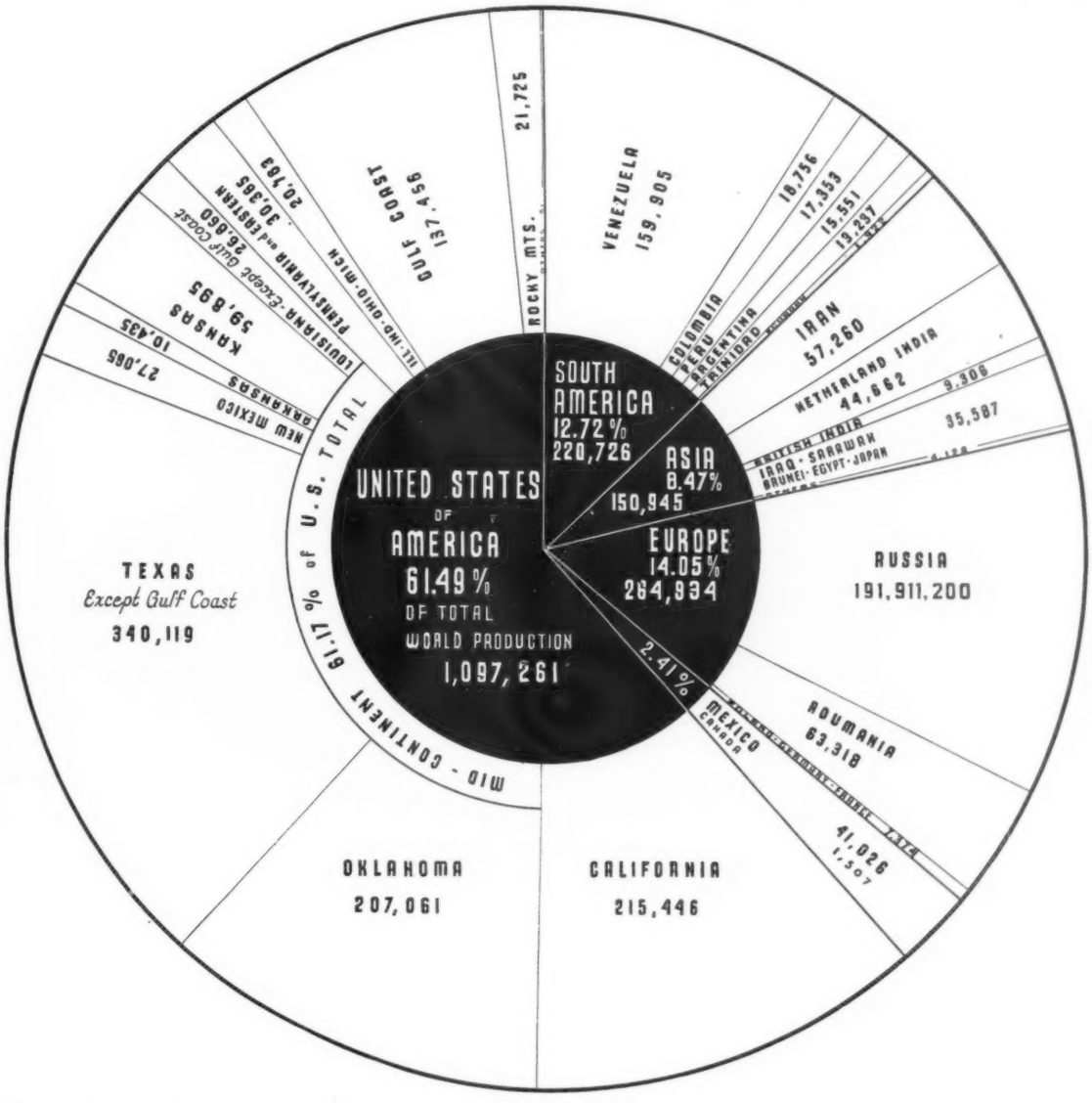


Chart shows world crude oil production in 1936 by continents, countries and major divisions in barrels of 42 U.S. gallons, 000 omitted.

WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Industry. ***Edited by Dr. O. W. Willcox***

Petroleum Geology

Possibility of Oil and Gas Production from Paleozoic Formations in Europe.—W. A. J. M. van Waterschoot van der Gracht, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 20 (1936), No. 11, pp. 1446–1493.

A large part of the oil and gas produced in North America is obtained from paleozoic rocks. All the geological conditions required for accumulation and production are present in the Paleozoic fields of the Mid-Continent and Appalachian provinces. In Europe, practically no Paleozoic oil is known, though the geologic sequence and history are so similar in the two continents that geologists commonly point out the comparability. The only real difference is a matter of overburden, or depth below the surface. In Europe, there is a very thick blanket of Mesozoic and Tertiary formations overlain by heavy glacial drift. Admitting the many problems of folding and unknown complications with depth, the writer believes that Paleozoic accumulations of petroleum may be expected in Europe.

Geomorphology of Gulf Coast Salt Structures and Its Economic Application.—C. H. Ritz, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 20 (1936), No. 11, pp. 1413–1438.

The importance of rim synclines, around Gulf Coast salt domes, as structures affecting the migration and accumulation of oil and gas has not been generally recognized. The synclines may divert the migrating oil, in those formations old enough to be affected by subsidence into the syncline, around the dome, and on up dip. They may also overlap with synclines of other domes to form effective traps for the accumulation of oil and gas in the interdomal area. The synclines may be circular, with the dome in the center, circular with the dome in an eccentric position, or irregular in shape, depending largely on the geologic conditions affecting the migration of salt into the dome during the entire history of the growth of the dome.

Differential upward growth of the salt is believed to be caused largely by the differential rate of flow of salt into the dome. Under the resultant forces it is believed that the vertical axis of the dome may migrate a distance as great as the radius of the dome. Such migration of the vertical axis is of interest to the geologist primarily because of the effect it may have on the structure of the oil-bearing formations.

The economic conclusions are as follows.

1. Overlapping peripheral sinks may be of major economic importance in the future Gulf Coast oil business.
2. Prospecting on a dome known to have a well developed rim syncline on the downdip side is extremely hazardous and, except in cases of rare good fortune, unprofitable.
3. Large shallow domes are most likely to have well developed rim synclines.
4. Extreme caution should be used in prospecting formations older than the Frio on any Gulf Coast dome because of the probability that less and less oil in progressively older formations has ever reached the dome in commercial quantities.
5. High wells, due to the uplift of the dome, may exist outside the peripheral sink of the dome, a condition which is likely to lead the subsurface geologist astray in his search for structure.
6. Peripheral faulting, due to decrease in diameter of the dome with depth, may seal off accumulation of oil from the dome and cause reservoirs to be formed somewhat farther from the dome than the common type of flank reservoir.

Subsurface data, recently made available to the writer, indicates that rim synclines are much better developed in the younger formations of the southern coastal zone than was believed at the time of the writing of this paper. Consequently the possibility of discovering residual high type oil fields in this province seems greatly enhanced.

Mineral Characteristics of Sands from Seven Gulf Coast Producing Horizons.—M. T. Halbouty, in OIL WEEKLY, vol. 84 (1936), No. 2, pp. 36–46.

The author made a study of the petrographic and physical characteristics of sands in the Gulf Coast region of Texas and Louisiana to determine whether or not sands of certain zones and formations might be recognized. In this connection the content of recognizable minerals was especially examined. On the whole there are 17 of these minerals, some of which, like quartz, zircon, leucoxene, rutile, biotite, cyanite, pyrite, chalcedony and staurolite are either so very abundant or so very rare as to be of no value for correlation purposes. Magnetite is common but is especially abundant in the Frio, Muscovite is rare in all sands except in the Cockfield and Upper Saline Bayou series where it is very common, so it is considered as of correlative value. Glauconite is also abundant in the form of large and well developed pellets in these series and this fact is also of correlative value. The Cockfield and Upper Saline Bayou series are distinguished in that they are the only formations to contain garnet, although even here this mineral is rare. Titanite is found in the Frio, Cockfield and Upper Saline Bayou series but is rare in each case; still, the presence of the mineral in each of these zones is of correlative value. Chalcopyrite was found only in the Cockfield zone, and only in several samples of sand; further study may show it to be of correlative value. Calcite was found to occur only in the Middle Oligocene formation.

The Frio formation contains a smaller variety of minerals than any other sand. The Cockfield sands have the greatest variety. Certain local petrographic characteristics of some importance were found in separated oil fields, and it is thought that further petrographic research on all sands in the Texas-Louisiana Gulf Coast geologic section will be warranted.

Geophysics

Geophysical Regional Surveys as the Basis for Discovery of New Oil Deposits.—O. Barsch, before German Society for Mineral Oil Research, Berlin, 1936.

The object of regional geophysical surveys, especially in flat regions of wide extent, is first to obtain a general idea of the tectonics or structure of the deeper layers and, in the second place, to explore individual structures that are likely to contain oil. As an example of such a program the Hannoverian region is cited. Here some 35 new salt plugs have been located. Under existing circumstances it is impossible for the German oil industry to investigate, within a reasonable time, the flanks of all these domes by means of the drill, so the problem arises of making the best selection of the most likely domes. For this purpose use has been made of a rule suggested by past experience, which is that oil is most likely to be found in those domes that occur on the edges of the buried mountain masses of this region.

Application of this general rule has disclosed a similar condition in Schleswig-Holstein where there has been found a subterranean mountain massif extending from the mouth of the Elbe to the Bay of Flensburg, with a second massif to the east and a deep hollow in between. Here the salt plugs lying around the edges of the buried mountain massifs have also been proved to be the most likely locations of oil-containing structures.

Geophysical Prospecting for Oil in 1936.—J. C. Karcher, in MINING & METALLURGY, vol. 18 (1937), No. 361, pp. 28–29.

During 1936 there were in the field more than 10 magnetometer parties, 9 gravimeter parties, 5 electrical surveying parties, 50 torsion balance parties, 200 seismic reflection parties and several refraction parties within the United States. There is a tendency to

abandon the pendulum in favor of the gravimeter; the magnetometer continues to be used for preliminary explorations, but both require checking by torsion balance or preferably by reflection seismograph. Torsion balance is also being used for reconnaissance purposes, with subsequent checking by seismic reflection; continued improvement in torsion balance construction is resulting in increased rapidity of surveys. The refraction seismograph appears to have been almost completely displaced by the reflection seismograph owing to greater precision of deep measurements. There has been marked improvement in methods of conducting seismic reflection surveys in swamps and open water areas. On the Texas and Louisiana Gulf Coasts a wildcat well is seldom drilled without being surveyed by the Schlumberger electrical method.

Results of geophysical exploration during the year have been the discovery of a new major oilfield and two new gas fields in California; at least eight new oilfields (one of major importance) have been discovered in the Texas Gulf Coast; several oil and gas fields of minor importance have been found in Kansas and Oklahoma, one oilfield in southern Arkansas, one oilfield and two gas fields in northern Louisiana and three new oil fields in southern Louisiana.

Exploration by the Reflection Seismograph in the Gulf Coast of Texas and Louisiana.—E. E. Rosaire, before Institution of Petroleum Technologists, November, 1936 (London).

The reflection seismographic method of geophysical exploration is now regarded as the most approved method for the definition of possible oil structures. In the words of the author:

"The law of diminishing returns has run its course for all methods of finding power less than that of the reflection seismograph, so that there is less and less justification for exploration by any method available but the reflection seismograph.

"Additional exploration by the reflection seismograph is justified only for those operators who have accumulated appreciable areal surveys by this method, and who thus have a material patchwork upon which to make a blanket exploration.

"Smaller operators, who do not have this prerequisite patchwork, are not justified in exploration or prospecting in this area until a method of still higher finding power is made available."

However, the opinion is expressed that prospect development in a particular area should not be initiated by any given method until the area has been explored by appropriate methods of lower cost. As an example it is stated that the most successful operator of the reflection seismograph in the Gulf Coast to date is the Stanolind Oil and Gas Company, which has steadfastly adhered to the possibility of locating prospects by the torsion balance and evaluating them by the reflection seismograph.

The paper concludes with the opinion that foresighted operators in the Gulf Coast will probably do two things:

1. Make intelligent investments in possible new methods of oil-finding with potential finding powers still higher than are available in the methods now in use.

2. Complete their blanket explorations of this area by the reflection seismograph in the shortest possible length of time and at the lowest possible cost. This means the purchase and acquisition of otherwise negative data already secured in this area by other operators. The completion, and proper interpretation, of such a blanket exploration should result in complete information as to all the possible marginal and submarginal prospects which can be found in this province by the reflection seismograph, which method has the highest finding power of any method used to date in this area on any intensive scale.

Drilling

Portable Rotaries in East Texas.—Mitchell Tucker, in OIL & GAS JOUR., vol. 35 (1937), No. 34, pp. 35–37.

Although nearly 22,000 wells have already been drilled in the East Texas field, new producers are being added at the rate of 30 to 40 per week, and contractors have reduced drilling time and expense to what appears to be their lowest terms, largely through use of more completely unitized light rotary rigs and portable cable or rotary rigs mounted on trucks for drilling-in.

With ten-inch surface casing it is not unusual to complete a well in seven days, including setting time for the cement around the oil string. The formations are easy-drilling and it is not uncommon to make 2,000 ft. of hole in the first 24 hours. Portable rigs make it possible to move to a new location in record time.

During the past year the most important development in East Texas drilling has been the growing use of the portable reverse-circulation rotary-rig for drilling-in purposes. This unit was originally designed for clean-out work but has become adapted to completion of wells under pressure, using oil as drilling fluid. The method of operation is similar to the ordinary rotary rig except that by an arrangement of by-passes circulation may readily be reversed to move fluid down casing and out tubing, or vice versa. In reality the process effects reverse-circulation rotary and pressure drilling, using crude oil as the drilling medium. Through use of 2-inch tubing or small drill pipe, reverse circulation permits sufficiently high velocities to carry out cuttings of reasonable size at a rapid rate. The advantage of this method in well completion work is that the sand is kept free from mud contamination; accurate logging can be accomplished, as cuttings represent only the formation drilled when clean oil is used as drilling fluid, and formations can be logged (it is said) even to the inch. A clean sand face is preserved at all times.

Cementing Casing at Top and Bottom in One Operation.—R. M. Cook, in PETR. ENG., vol. 8 (1936), No. 1, p. 32.

In a 3,280-ft. California well the problem arose of cementing off all surface formations and at the same time cementing 8⅝-in. casing as a water string, the cement to be applied in two batches. One of these batches was to be around the shoe at the bottom; the other from a shale bed at 1,000 ft. to the surface. The first batch was pumped through a float shoe with ball valve, 450 sacks of cement being used in this operation. As soon as this cement was in place pressure at the surface was relieved to check the back pressure valve in the float shoe. A Lane-Wells gun perforator was then run and 10 holes shot in the casing at 1,050 ft. about the center of the shale bed. Circulation through the perforations and up to the surface behind the casing was obtained and 400 sacks of cement were pumped in for the second batch. When cement returns were obtained at the surface the upper plug was set below the perforations, giving assurance that the cement would seal off the holes in the pipe. The 8⅝-in. casing was in a 12¼-in. hole. In addition to saving some of the cement that would be required for cementing the casing from top to bottom, the special point of this operation was to obtain a better bond at the shale than might result by the one-operation method.

Oil Well Operation

Development of Porosity in Limestones.—W. V. Howard and Max W. David, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 20 (1936), No. 11, pp. 1389–1412.

The continuous porosity possessed by limestone reservoirs is developed mainly by solution by acids resulting from the bacterial decomposition of organic matter and by carbon dioxide formed during these processes.

Porosity is shown to be of three types, namely, equi-solution, channel, and cellular. In the development of these types of porosity, the composition of the rock and arrangement of mineral grains is important.

Reactions taking place within the reservoir, both prior and subsequent to the entrance of oil, may result in the formation of much secondary calcite. The effect of this material upon the results of acid treatment and also that of the insoluble residues released are touched upon briefly.

The Use of Flow Beans.—E. L. Davis, in OIL & GAS JOUR., vol. 36 (1936), No. 20, pp. 42–46.

The "bean," otherwise known as a "choke" in the Mid-Continent, is an orifice placed in the production lines from an oil well for the purpose of applying a back pressure on the flowing well to limit its rate of flow. The effect is to decrease the rate of production, and also to attain certain ultimate benefits, which are summarized as follows:

1. To prevent sanding up of the well. Too great a rate of inflow of oil and gas may entrain loose sand and bring it into the well, filling the hole and necessitating cleaning out. Also, too great a reduction of pressure in the well compared to that existing in the formation may, in extreme cases, cause a block of formation to shift toward the hole, collapsing the pipe.

2. To prevent cutting out of fittings at the well head due to sand blasting. Sand cuts due to high velocity. Beaning reduces the velocity of the fluid in the tubing by compression until it is past the essential controlling fittings at the well. This cutting out used to be a rather common occurrence and was a source of great expense, including the danger of losing the well if the control fittings cut out, allowing the well to blow wild. This danger has been practically eliminated by means of improved equipment and technique.

3. To hold back encroaching edge or bottom waters. During rapid withdrawal of oil the more open and permeable sands give up their

oil first. Water follows the oil into the well through the same strata. Large volumes of water may make the well impractical to produce. Beaning is desirable to permit a more uniform withdrawal of oil from the sands and a uniform encroachment of edge waters through all the oil-bearing sands. This beaning needs to be done early before water encroachment has gone too far. It is of little benefit after water reaches the well.

4. Beaning is used to prevent what is called "heading" in a well. Heading consists of the well flowing strongly for short periods, followed by periods of no flow. During the flow period most of the oil and gas may be blown out of the well, which then requires a fill-up period until sufficient pressure accumulates to start flow again. This rapid alternating of periods of high- and low-pressure is a severe strain on the oil-well casing and formation. Beaning reduces the rate of flow of the heads and tends to spread out the flowing period. Thus it holds a relatively uniform pressure against the oil sand.

5. In line with the preventing of heading, beaning may be used to prolong the flowing life of a well that would otherwise need to be pumped.

6. A use of beaning that is rather modern is that of improving the gas-oil ratio. Gas-oil ratio is defined as cubic feet of gas per barrel of oil produced. Gas, by its expansion, is the chief agent in bringing oil into the well, at least during flush production. It is also necessary in lightening the weight of the oil column so that the formation pressure can flow it to the surface. It is desirable to conserve in the ground the extra amounts not necessary in producing the well.

Progress in Well-Acidizing Practice.—Leo H. Towers, in PETROL. ENG., vol. 7 (1936), No. 13, pp. 100–104.

The acid-treating process, originally employed for rejuvenating old wells, is now being employed in some instances with new wells as a measure for conserving reservoir energy and controlling gas-oil or water-oil ratios. In such cases an acid treatment is counted on to lower resistance to flow, to decrease the pressure drop and permit a higher subsurface flowing pressure, as well as a slower decline in formation pressure. Such control of the flow is valuable where proration requires an even rate of production.

A new use for acidizing treatment is to increase the capacity of input wells in water-flooding operations, especially where the flooded formation contains limestone; even in flooding operations in sandstone reservoirs acid has been used to dissolve precipitates that were obstructing flow of the water at the face of the well. The same idea has found application in the treatment of input wells for the disposal of salt water. In one such case, where a salt-water well was taking 30 bbl. an hour at 300 lbs. pressure, after acidizing it took at least 100 bbl. an hour at no pressure.

Another item of progress is the introduction of an acid with low surface tension that is recommended for tight formations on account of its greater penetrating ability.

An important advance in the placement of acid is the use of a jelling solution for temporarily plugging off porous formations below the point where acid is to be applied; this jell carries bacteria that destroy it in 24 to 36 hours, thus allowing the seal to come out with the oil. This process has been especially successful in the Fitts Pool, where oil is produced from many separate and distinct formations.

A distinct contribution to acidizing technique is the "two-pumps" method that is applied where porous gas sands are taking the acid intended for the oil pay; a high-pressure pump is connected to the casing head and a constant stream of oil is forced down the casing at the same time that acid is slowly pumped down the tubing to force it into the oil horizon.

An acid treatment today is almost double that of a year ago when the average treatment was 1,500 gals.; now it is more than 2,500 gals. Whereas stripper wells may be given 1,000 gals., new wells are given 3,000 to 10,000 gals. In one case an Oklahoma well was given 10,000 gals. and two weeks later 15,000 gals. In general, the only wells that have not benefited from acid treatment are in formations that are wholly sandstone.

Natural Gas

Influence of Automobile Design on Natural Gasoline.—C. C. Moore, Jr. and Robt. L. Stirton, in CALIF. OIL WORLD, vol. 39 (1936), No. 1473, pp. 10–11; 22–23.

Recent advances in design of automobile fuel systems make it possible for the gasoline producer to market much more volatile gasoline. This will increase the use of natural gasoline in motor fuels in the immediate future.

The introduction of such fuels to the market will increase the venting losses in automobiles and tend to direct the efforts of the automobile designer toward increasing economy by decreasing fuel line temperatures.

The combination of these trends will be to increase the percentage of natural gasoline in motor fuels over a long-time period.

It is regrettable that the automobile designers have not yet thought of a better way to suppress vapor lock than by simply ejecting the vapor into the atmosphere. The loss of gasoline arising from this practice is difficult to estimate, but the general trend of investigation has been to place it between 5 and 20 percent.

Petroleum Refining

Copper Sweetening Methods.—W. A. Schulze and L. S. Gregory, before Western Petrol. Refiners' Assoc., Wichita, 1936; Nat'l. Petrol. News, vol. 28, No. 41, p. 34.

This paper discusses in general terms various modifications of the copper sweetening process as applied to gasolines. One of the most important is a "solid" treating process, wherein a re-agent is prepared by impregnation of adsorbents such as fullers' earth and the like with the copper solutions, and the sour gasoline is contacted with this re-agent by filtration. The solid re-agent is continuously regenerated in place by dissolving a predetermined amount of air in the sour gasoline before it enters the filter. The sour gasoline is said to be sweetened so quickly that almost unbelievable rates of flow are possible. Hence these units are quite small as compared with the conventional sweetening plants. The authors enumerate a long list of troubles and inconveniences of the plumbite sweetening treatment that are obviated by the copper treatment, which is exempt from serious losses and forms no emulsions. Even the method based on use of copper solutions appears to have very distinct advantages. In one plant the re-agent cost is figured to be less than 0.1 cent per barrel, showing a saving of more than 90 percent of chemical costs in the plumbite doctor method.

Due to the extremely long life of the re-agent in the "solid" copper sweetening process, the definite minimum chemical costs have not been computed; in one case where 3,500,000 gals. have been treated the savings are calculated to be more than 98 percent of the chemical cost of the previously used method. First costs of plants using the solid re-agent method average less than $1.00 per barrel rated capacity, and this may be reduced if salvage material is available.

An important claim for the copper method is that in many instances it is possible to avoid the use of strong caustic which affects the natural gum inhibitors of the gasoline. The mercaptans are converted completely to desulphides, leaving no objectionable alkylpolysulphides or tertiary mercaptans that lead to formation of objectionable compounds during hypochlorite treating.

Use of Centrifugals in Modern Refineries.—R. H. Dolton, in PETROLEUM, vol. 32 (1936), No. 34, pp. 1–4.

The author (a DeLaval engineer) gives a summary of the uses to which centrifugal separators are being put in petroleum refining. The primary field of this equipment is in cases where two immiscible liquids are to be separated and where suspended solid materials are to be removed from a liquid; in this latter case it serves as a substitute for settling or filtering equipment.

The first use of centrifugal separators in petroleum refining was for the deparaffining of lubricating oils, especially for the removal of the so-called amorphous paraffin, which will clog nearly any filter. It is also applied to heavy oils containing crystalline paraffin in suspension, as such oils can hardly be filtered without dilution.

There are two principal methods of deparaffining an oil by centrifuging. One is a form of the Sharples process in which a light gasoline is used as a diluent, and a form of the Separator-Nobel method which employs a heavy diluent, chiefly heavy chlorinated hydrocarbons. In the first of these forms the paraffin, as the specifically heaviest constituent, is thrown against the wall of the centrifugal drum. This process is well adapted to remove amorphous paraffin and the so-called "medium" paraffins, which are plastic enough to flow along the wall of the drum, but which is not the case with crystalline paraffin. In the S-N method, which uses a heavy diluent, the paraffin is the specifically lighter constituent that trends toward the center of the drum, where both the amorphous and the crystalline variety are removed.

Centrifugals for deparaffining are built in capacities to handle 8 to 15 cubic meters of oil in 24 hours, and consume 4½ to 6 h.p. The cost varies from 10 to 25 shillings per ton of deparaffined oil, depending on dilution, cost of cooling, etc.

The second large field for centrifugal separation is in the continuous acid treatment of various petroleum products. In the acid treatment of lubricating oils, the acid and oil are mixed in a special centrifugal pump. After

allowing a short time for completing the reaction in an intermediate tank the oil and acid sludge are separated in the centrifugal separators. The separators for acid-treated lubricating oils have a capacity of 1,000 to 4,000 liters per hour, and for acid-treated cracked gasoline 5,000 to 8,000 liters per hour, with power consumption of 3 to 4½ h.p.

There are also a number of separator plants for the continuous handling of gasoline emulsions that are often formed in the doctor process, for clarifying oils from the clay filters, for dewatering crude distillates before acid treatment, etc.

The increasing use of solvent extraction in the refining of lubricating oils has given the centrifugal separator a place in the separation of extract and raffinate. At least one such plant is used in connection with the phenol extraction process, and has shown decided advantage over separation by settling. The centrifugals used in this plant turn at 6,000 r.p.m.

COST OF POLYMER GASOLINE.—E. Ospina-Racines, in WORLD PETROLEUM, vol. 7 (1936), No. 10, pp. 470–479; 559.

Present yields from commercial polymerization processes range from 2.8 to 14.4 gals. of crude polymer per 1,000 cu. ft. of gas charged, the larger yields being obtained from gas consisting of hydrocarbons containing three or four carbon atoms in the molecule (methane and ethane being previously eliminated). A yield of 14.4 gals. represents a conversion of 70 percent, whereas cracking gives, at most, a conversion of 55 percent. The theoretical yield of 60 deg. A.P.I. gasoline from butane of 0.58 spec. grav. is 78.5 percent. At the present time polymer gasoline has a high value as an agent for conferring good anti-knock qualities (high octane rating) on inferior gasolines. In a way this is a noteworthy step in petroleum conservation, as much less cracking stock will be sufficient to produce the same volume of marketable motor fuel, and producers of straight run or third grade gasolines can purchase either tetraethyl lead or polymer gasoline for improving their product. Under present market conditions the production of blending polymer can sustain a manufacturing cost of 6.30 to 7.12 cents, depending on location. The manufacturing cost will depend on the price put on butane as the most acceptable raw material. If butane costs 3.20 cents a gallon at the refinery, and the conversion is 55 percent, the polymer gasoline certainly cannot cost less than 5.8 cents. The future of polymer gasoline to some extent depends on whether the cost of producing tetraethyl lead will or can be further reduced.

RAPID RECOVERY OF DOCTOR SOLUTION.—J. C. Albright, in NAT'L. PETROL. NEWS, vol. 28 (1936), No. 38, pp. 24–28.

The usual practice of regenerating doctor solution in Michigan oil refineries, as well as in other parts of the country, is to withdraw the used solution from the gasoline treating tank, and heat and blow it with air for about 24 hours, about 20 bbl. of doctor solution being used for each 400 gal. of distillate, gasoline or kerosene.

A new process, devised by Reid Brazell, superintendent of the Leonard Refineries, uses the principle of turbulent contact in a vertical tower, which consists of a 6-in. pipe, 12 ft. in length and closed at top and bottom. In this pipe are inserted 13 baffles, alternately arranged, each leaving a clear space of 1½ in. between baffle edge and inner wall of the pipe. The spent doctor solution, previously heated to about 165 deg. F., is pumped in at the bottom of the tower while compressed air is blown in at the bottom from the opposite side. The mixture of air and doctor solution issues from the top of the column and is conducted to the bottom of a receiving tank where it is discharged through a "spider" of perforated pipe. By this means the doctor solution is regenerated in about 2 instead of 24 hours. The amount of compressed air used has not been exactly determined, but the hourly rate perhaps does not exceed that of the conventional process. The lead used at the Leonard Refinery is a sublimed lead instead of the usual variety. No theory is advanced as to why the Brazell method is so successful in curtailing the time of regeneration.

MEASUREMENT OF FLOW RATES OF HOT-OIL STREAMS BY THE DILUTION METHOD.—T. A. Mangelsdorf, B. L. Sowers and A. J. Deuster, in IND. ENG. CHEM., analyt., edit., vol. 8 (1936), No. 6, pp. 440–442.

For test purposes the dilution method of measurement is desirable for determining rates of flow of internal recirculating hot-oil streams on commercial cracking units and distillation equipment. Previously this method has not been used for oil streams because there was available no material which was known to be satisfactory as a diluent.

Commercial naphthenic acid produced as a by-product of the refining of naphthene-base crudes has been found suitable for use in this service. Its concentration may be determined accurately even in dilute solutions with the modified method herein reported, it is sufficiently stable, it is non-corrosive, and its cost is moderate.

Tests on a commercial cracking unit indicated that charge rates determined by the dilution method, using naphthenic acids as the diluent, checked within two percent the rates determined by tank gagings.

Petroleum Chemistry

OIL OXIDATION.—Ralph W. Dornte, C. Vaughan Ferguson and Caryl P. Haskins, in IND. ENG. CHEM., vol. 28 (1936), No. 11, pp. 1342–1345.

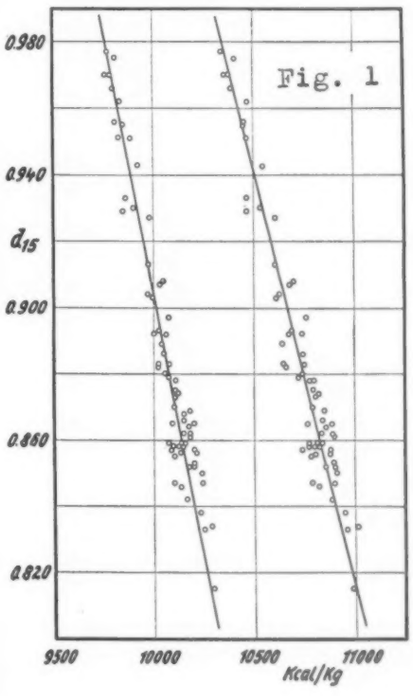
The rate of oxygen absorption in a circulatory system is applied to the study of lubricating oils whose rate of oxygen absorption continuously decreases. This decrease is probably due to a decreasing concentration of reacting components of the oil. It is simpler in this case to treat the oxygen absorption data by an empirical equation which indicates a retardation of the reaction by the oxidation products. The rate of reaction varies linearly with the partial pressure of the oxygen. The principal oxidation products are water, carbon dioxide, and acids; no peroxides are found and only small amounts of carbon monoxide can be detected. The net heats of activation for oils of this type vary between 33,000 and 73,000 calories.

The catalytic effects of copper, iron, tin, and lead are studied by the oxygen absorption procedure. The catalytic effect of these metals depends upon the oxygen pressure and the ratio of metal surface to oil. The rate of oxygen absorption in the presence of copper is constant, which indicates a change in the type of the oxidation reaction. The net heats of activation for the catalyzed oxidation of the oil are determined for a fixed metal-oil ratio. Only copper and lead have a marked catalytic effect on the oxidation of the oil.

DETERMINATION OF ANALYTICAL DATA OF MINERAL OIL ON THE BASIS OF AEROMETRIC MEASUREMENTS.—Maxmillian Marder, in OEL UND KOHLE, vol. 12 (1936), No. 46, pp, 1061–1067; No. 47, pp. 1087–1093.

In this paper the author shows, on the basis of extensive data, that the fuel value, the carbon and hydrogen content and the carbon-hydrogen ratios of crude petroleum and petroleum products (tractor oil, Diesel oil, fuel oil, kerosene) can be determined from specific gravity measurements. The same holds for the ignition qualities of Diesel fuels.

The principal basis for this conclusion is the extensive work of Constam and Schlapfer that was published in five numbers of vol. 57 (1913) of the *Zeitschrift der Verein Deutschen Ingineure*. These investigators determined the

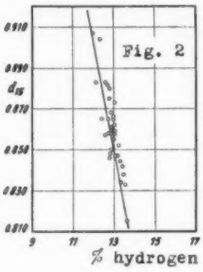


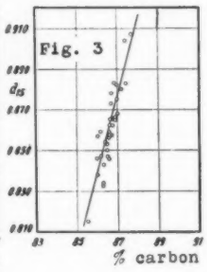
upper and lower fuel values, the density, the proximate and elementary composition and the carbon/hydrogen ratios of 117 crude oils and fuel oils from all the principal oil fields of the world. Besides data found in the literature, new determinations were made on 68 oils of different origins and methods of treatment.

The relations found in this investigation are illustrated in the accompanying graph (Fig. 1) where gravity at 15 deg. C. is plotted against heat value in Kcal/kg. The line to the right shows heat of combustion (upper heat value) calculated from the carbon and hydrogen content, the line to the left shows the lower heat

value, which is the calculated heat of combustion with a correction for ash and sulphur, with a further subtraction of 54 Kcal for each one percent of hydrogen content. It is thus apparent that the heat value of an oil can be very closely estimated from its density, and it is even conceivable that the heat value can be read directly from a hydrometer spindle graduated to show heat units, using a correction of 70 Kcal for each one percent of sulphur.

These relations readily lend themselves to a determination of the hydrogen and carbon





contents of the oil, and from these the carbon/hydrogen ratio. (See Figs. 2 and 3.) The investigation was extended to 200 Diesel fuels, from which the relation of gravity to cetene number (engine determination) is deduced. The density data and cetene number, when corrected for boiling data, produce a very smooth curve. One cracked Diesel oil gave somewhat abnormal figures.

Free Sulphur in Petroleum Distillates.—S. Comay, in IND. ENG. CHEM., analyt. edit., vol. 8 (1936), No. 6, pp. 460–462.

Free or elementary sulphur is present in nearly all cracked and straight-run gasolines, although its presence in crude oils has not been generally demonstrated. The only method for determining free sulphur generally used by the oil industry is the A.S.T.M. copper-strip method, which is not reliable in certain cases, especially in the presence of peroxides. Hence, for a reliable quantitative estimation of free sulphur any peroxides present must be reduced. This reduction may be effected by sulphur dioxide or a water-alcohol solution of ferrous sulphate, but the author prefers the use of powdered iron (reduced by hydrogen) and hydrochloric acid in a special apparatus, of which he gives a description. The evolved hydrogen sulphide is caught in an ammoniacal solution of cadmium chloride, which is titrated with iodine solution by the usual procedure.

Petroleum Physics

Heat Transfer and Pressure Drop of Liquids in Tubes.—E. N. Sieder and G. E. Tate, in IND. ENG. CHEM., vol. 28 (1936), No. 12, pp. 1429–1435.

Data are presented on heat transfer to three oils of widely different temperature coefficients of viscosity in viscous flow in a tube for both heating and cooling. The results are correlated in terms of main-stream fluid properties by a method which takes into account the viscosity gradient of the fluid in the tube by means of the ratio μ_s/μ_w, where μ_s is the viscosity of the fluid at its main stream temperature and μ_w is its viscosity at the temperature of the tube wall. The data for heating and cooling are brought into agreement on this basis. The method of correlation is then applied to data in the literature on heat transfer and pressure drop in both the viscous and turbulent regions. Again heating and cooling data are brought into substantial agreement. Application of the method of correlation to the design of heat-exchanger equipment is discussed. Curves are given from which local values of the heat transfer coefficient and friction factor within tubes can be predicted.

The Simplest and Most Accurate Viscosimeter.—L. Ubbelohde, in OEL UND KOHLE, vol. 12 (1936), No. 42, pp. 949–974.

In this extensive article the author, whose special field of research includes the theory of the internal friction of flowable liquids, gives a general conspectus of his work on the "suspended surface" which has resulted in the construction of a hanging drop viscosimeter of the highest accuracy and great ease of handling. The present form of the apparatus, in which the hanging drop is contained in a hollow cone, gives the kinematic viscosity in centistokes with no need for introducing correction factors. All possible sources of error are so thoroughly excluded that, in the opinion of this distinguished specialist, there will hereafter be no excuse for a questionable viscosity measurement. The same principle is applied to the measurement of surface tension.

Efficiency of Rectification Column Plates.—E. Kirschbaum and C. A. Andrews, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 22 (1936), No. 158, pp. 803–820.

It was ascertained that the rate of change of liquid concentration during its flow over a rectification plate varied, and that the greater part of the fraction volatilized from the liquid was removed during the earlier part of the flow. The results of a series of tests on liquids of different ethyl alcohol-water concentrations are given in the form of typical travel-concentration or concentration gradient curves.

These curves indicate that a modification should be made to the assumption that the volatile fraction removal gradient is a straight line. They show that the mean concentration of the liquid on a plate is not the arithmetical mean as deduced from liquid samples taken at the entrance to, and the exit from, the plate. True mean concentration can be found by taking into account the shape of the travel-concentration curve applicable to that plate under the working conditions for which the curve was obtained. This can be done by ascertaining the area under the curve by means of a planimeter.

On the basis of the mean concentration so obtained the real or actual efficiency of the plate is calculated.

Relation Between Molecular Weight and Concentration of Petroleum Fractions in Dilute Solution.—Harry T. Rall and Harold M. Smith, in IND. ENG. CHEM., analyt. edit., vol. 8 (1936), No. 6, pp. 436–439.

The molecular weights of oils as usually calculated from either cryoscopic or ebullioscopic data generally change uniformly with concentration. This necessitates a series of determinations so that the curve through the determined values may be extrapolated to zero concentration.

There appears to be a relation between the slope of the molecular weight-concentration curve and the value of the extrapolated molecular weight. If this relationship is equated with the formula connecting the concentration and molecular weight, the result is an equation that will give the value of the extrapolated molecular weight from one determination.

Equations of this character are given for benzene and ethylene bromide. Comparisons of calculated and actual results are also given which show that for the data presented the suggested method applies fairly well.

Asphalt and Tar

Hydrogenation of Tar Under Different Conditions.—H. Winter, G. Free and H. Monning, in REV. PETROL., No. 710 (1936), p. 1716.

The most favorable temperature for the hydrogenation of coal tar is about 480 deg. C., and the most favorable pressure about 200 atmospheres. Ammonium molybdate, supported on silica gel, was used as a catalyzer. Aromatic, napthenic, olefinic and paraffinic hydrocarbons were found among the products. The light oils distilling up to 200 deg. C., when freed from phenols, were suitable for motor fuel, having octane numbers of 66 to 69. However, the product distilling between 200 deg. and 300 deg. C. did not make a good Diesel fuel, but by repeated hydrogenation of the fraction boiling above 200 deg. C. the whole amount of the tar could be transformed into light fuels. It is noted that hydrogenation of tar containing some water is more convenient than hydrogenation of the perfectly dry tar.

Influence of Time on the Viscosity of Cut-Back Asphalts.—Celestino L. Ruiz, in BOL. INFORM. PETROL. (Argentina), vol. 13 (1936), No. 145, pp. 57–60.

The most frequent cause of rejections of cut-back asphalts is an excess of viscosity over specifications. It is generally supposed that this increase of viscosity is due to loss of solvent by evaporation during transportation or storage. Although such may be the case in some instances it is not the only one, because products of the same type and origin with the same quantity of solvent and of asphalt base may show differences in viscosity amounting to 30 percent.

The fact is that a cut-back is not a true solution of asphalt in a petroleum distillate; a bituminous asphalt is a lyophile colloidal dispersion in a dispersing oily medium, so the addition of a distillate does nothing more than dilute the dispersing medium, and the mixture still retains its character as a colloidal dispersion (organosol). Hence it is natural that dilute colloidal dispersions of asphalt should exhibit the phenomena of aging that are evidenced by an increase of viscosity.

To illustrate the matter the author stored two commercial cut-back asphalts, one a rapid and the other a medium hardening grade, at the ordinary temperature in closed vessels and

determined the viscosities at monthly intervals. The results showed an appreciable increase of viscosity as a function of time with no loss of solvent.

This seems to be in line with the general rule enunciated by Nellensteyn, who showed that the behavior of an organic solvent as a diluent or as a flocculant of bituminous asphalts depends on its surface tension; if this is less than 24 to 26 dynes/cm. it will act as a flocculant, and if it is above that figure the liquid will act as a diluent. According to the International Critical Tables the naphthas have surface tensions of 19 to 23 dynes/cm. and hence they give rise to a more or less marked flocculation, depending on the character of the solvent.

However, the process is reversible and the original viscosity of the cut-back asphalt can be restored by heat, which destroys the micellar agglomerations.

ADSORPTION OF BITUMEN AND ITS CONSTITUENTS BY CERTAIN NATURAL AND TREATED EARTHS.—H. T. Lorne, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 22 (1936), No. 154, pp. 542–561.

The "efficiency" of a filler is defined as the power of increasing the melting point and hardness of a bitumen by the addition of a certain proportion of the filler without, at the same time, rendering the mixture unduly dry and brittle. Experiments show that efficiency in this sense is not proportional to either the adsorbent or decolorizing properties of the filler, although when an earth is activated by heat so as to improve its decolorizing ability, its "efficiency" is also improved. Kieselguhr is an example of an earth having great porosity, few really small particles and no decolorizing power and which, nevertheless, has a great effect on the properties of a bitumen. However, the adsorbing property is of importance in some respects; active earths probably bind the asphaltenes, and so the greater the adsorbing power of the earth the greater its binding power. Thus the adsorbing power for asphaltenes takes rank with fineness of division and porous structure in selecting a filler for a particular bitumen. Spent fuller's earth should make good fillers.

Petroleum Reserves

RECENT DISCOVERIES AND PRESENT OIL SUPPLY IN CALIFORNIA.—Harold W. Hoots, in BULL. AM. ASSOC. PETROLEUM GEOLOGISTS, vol. 20 (1936), No. 7, pp. 939–950.

Demand for California crude requires the production of about 200,000 bbl. annually. Discoveries during the last four years have added only an estimated 135,000 bbl. to the reserve supply. Present producing areas, if curtailment is entirely successful, will yield oil at a rate adequate for expected demand until about 1939. It is estimated that all resources of the state, including present shut-in production, will be required to meet the demand in 1940 unless important new discoveries be made. The discovery of suspected deep zones may delay a shortage of oil until 1943–45. New fields are becoming increasingly desirable and may be expected to alleviate or further delay actual shortage.

Petroleum Uses

METALLIC SOAPS FOR THICKENING MINERAL OILS.—C. J. Boner, in IND. ENG. CHEM., vol. 29 (1937), No. 1, pp. 58–60.

Metallic soaps used in grease manufacture are limited, in the main, to those of aluminum, calcium, lead, and zinc. Although sodium soaps are largely used, they are not generally classified as metallic soaps. There is a possibility that some theory can be developed, similar to that for driers used in paints and varnishes, as to why metallic soaps thicken mineral oils. With this object in view, a number of metallic soaps were made and tested for their ability to change the consistency of mineral oils.

Practical considerations led to the selection of fatty acids which were predominantly saturated. Experience has determined that the most desirable calcium-base greases result from the use of a mixture of oleic, palmitic, and stearic acids of a titer of 32 to 44. Acids of lower titer give soft greases, and with higher titer smoothness is sacrificed. Similarly, in the manufacture of greases with aluminum soaps, aluminum stearate provides the greatest thickening whereas the oleate tends to give a more fluid grease. Likewise, lead stearate gives a grease of much heavier body than the oleate or naphthenate.

Thus the acids used—namely, double-pressed stearic acid and lard fatty acids—fall in the classification of those largely used in practice.

Eighteen metals were combined with two fatty acids of different titer to form metallic soaps. These soaps were heated to the same temperature with two mineral oils and cooled to find whether grease resulted. Grease was formed with soaps from nine of the metals. These nine, with the exception of aluminum, were divalent or gave divalent compounds.

Soaps of metals with the lowest atomic weights produced greases of best transparency. In general, soaps of the more basic metals produced softest greases. Water as an emulsifier was not required except in the case of calcium and strontium soaps.

Consistency was heaviest and dropping point highest in greases made from the highest titer acid. Behavior of the metallic soaps in both naphthenic- and paraffin-base oils with a Saybolt viscosity of 100 at 100 deg. F. was similar. Although the entire metal field was not covered, indications are that divalent combinations furnish the most promising and satisfactory bases for lubricating greases.

IGNITION QUALITY OF DIESEL FUELS.—Committee Report, JOUR. INST. PETROL. TECHNOLOGISTS, vol. 22 (1936), No. 157, pp. 774–778.

The Technical Committee on Diesel Fuels of the Chemical Standardization Committee of the Institution of Petroleum Technologists have carried out a considerable amount of work in regard to the determination of the ignition quality of Diesel fuels. As the result of this work they have prepared a draft tentative method of engine test for Diesel fuels. In publishing this draft the Committee hope that those concerned with the testing of Diesel fuels will make use of the method and of the secondary reference fuels in experimental work, and will also put forward any comments which would assist the Committee in their deliberations.

It is not yet possible to make a final decision regarding the primary reference fuels, but two secondary reference fuels have been selected, and the specifications of these are given in the draft method. The complete correlation of the secondary reference fuels with primary reference fuels is under consideration. The cetene number of the high-ignition-quality reference fuel is approximately 80, and that of the low-ignition-quality reference fuel is approximately 20. Supplies of the two secondary reference fuels are in course of manufacture and will be available for purchase from the Anglo-Iranian Oil Company.

Comments should be addressed to the secretary, Chemical Standardization Committee, The Institution of Petroleum Technologists, Aldine House, Bedford Street, Strand, London, W.C. 2.

Petroleum Economics

DETERIORATION OF REGENERATED TRANSFORMER OILS.—Franz Skala, in PETROLEUM, vol. 32 (1936), No. 50, pp. 1–6.

It is frequently observed that certain regenerated oils will stand the Baader aging test but will show a very unfavorable tar test. This observation is experimentally confirmed by the author. Old transformer oils were given the conventional regeneration treatment with concentrated sulphuric acid, washing and filtering over fuller's earth. The oil thus regenerated was then subjected to the tar test under the conditions prescribed by the Verein Deutschen Ingenieure, which require that after passing oxygen through the oil at 120 deg. C. for 70 hours, the oil shall remain perfectly clear and show a saponification number not greater than 0.3 and will deposit no sediment not soluble in benzin. There is a marked difference in the behavior of different regenerated oils under this test. The explanation seems to be (Gurwitsch, Schlapfer) that transformer oils which resist the tar test contain small amounts of resinlike, sulfur and oxygen-containing substances which act as oxidation inhibitors or protecting substances. If these inhibitors are destroyed as the result of age, or are "over-refined" by a too drastic acid treatment, the hydrocarbons of the oil become especially accessible to the action of oxygen. These inhibiting substances are to some extent removed by clay filtration after the acid treatment. This was verified by filtering an acid-treated oil over clay and extracting the clay with benzol. The filtered oil showed a poor tar test, whereas the same filtered oil to which a portion of the benzol extract was restored gave a good tar test.

It was also found that regenerated transformer oils that showed poor tar tests could be made fit for re-use by mixing with new oil that has not been over-refined to the point of removal of the natural oxidation inhibitors. The proportions will vary, but a 1:1 mixture may be considered safe.

FRENCH AUTONOMY IN AUTOMOTIVE FUELS.—Ramadier, in IND. DU PETROLE, vol. 4 (1936), No. 11, pp. 29–31.

An examination of all pertinent facts leads to the conclusion that at the present time, and apparently for some time to come, France will not be able to procure, from indigenous sources, more than about 15 percent of its peacetime

needs for light motor fuels, even at a high price for domestic products. In time of war this proportion will fall to three or four percent, because all the currently produced alcohol and benzene will not then be available for fuel purposes. Even with a vast program of coal hydrogenation it would be difficult to obtain more than 10 percent of war requirements. The fact is that in time of war there will be not only a large need for gasoline, but also for Diesel oil, lubricating oil, and especially fuel oil for bunkering ships of war. An interruption of the supply of these products would paralyze military operations as effectively as a lack of gasoline.

For France there is, therefore, only one real choice. In time of peace the establishment of a substitute-fuel industry would involve an enormous expense and would be an economic absurdity, if not a financial impossibility. In the case of an armed conflict only an abundant stock, accumulated in advance, would assure a supply of liquid fuel to meet the most pressing demands.

THE POLICY OF SUBSTITUTE MOTOR FUELS.—Oskar Tokayer, in PETROL. PRESS SERVICE vol. 3 (1936), No. 36, pp. 281–283.

An examination of the progress made in the production and utilization of substitute motor fuels is limited, to a minor extent, by the fact that statistics are available only for liquid fuels, that is benzol, synthetic gasoline, alcohol and shale oil gasoline. In the case of other substitute fuels, for example, wood charcoal, producer gas, etc., consumption is on so small a scale that no detailed figures are forthcoming.

From available figures it appears that production of petroleum and production of petroleum substitutes compare as follows:

World Production in Tons

Year	Crude Oil	Substitute Motor Fuels
1932	180,000,000	1,067,000
1933	197,000,000	1,349,500
1934	208,000,000	1,694,000
1935	226,000,000	2,002,000

In comparison with the volume of world petroleum production, substitute fuels are thus still a negligible quantity. But even if we take as a basis the world consumption of light motor fuels only, which for 1935 may be estimated at about 75,000,000 tons, the proportion of substitute fuels to total requirements is not more than 2.6 percent.

As regards individual countries, there are naturally very large variations in the proportion of substitute fuels to total requirements of light motor fuels. The following table summarizes the position in the more important European countries in 1935:—

	Consumption of light motor fuels (tons)	Substitutes Total (tons)	Substitutes % of consumption
Great Britain	4,400	292	6.6
France	2,685	355	13.2
Germany	1,930	855	44.3
Italy	501	16	3.2
Spain	436	13	3.0
Sweden	410	14	3.4
Holland	400	4	1.0
Belgium	360	8	2.2
Denmark	268	—	—
Switzerland	219	—	—
Czechoslovakia	235	51	21.7
Austria	143	10	7.0
Total	11,987	1,618	13.5

These figures are very instructive. They show, in effect, that with the exception of Germany there is no single important consuming country in which the production of substitutes has made such progress as to offer any serious competition to the demand for imported gasoline. Apart from Germany, which is responsible for more than half of the consumption of substitutes in these 12 countries, the remaining 11 used substitutes from domestic raw materials for only about 7.6 percent of their total consumption of light motor fuels, which amounted to over 10,000,000 tons last year. In all these countries, therefore, gasoline obtained from natural petroleum is still supreme as a motor fuel.

CONSERVATION AND STABILIZATION SYNONOMOUS IN THE PETROLEUM INDUSTRY.—Virgil R. D. Kirkham, before Independent Petroleum Assoc., Oklahoma City, Dec. 1, 1936.

In this address it is shown that in all the natural resources conservation is not necessary. In one class, the industrial metals and mineral fuels, it is necessary because there are limited deposits of non-replaceable materials. Of all the fuels, oil and gas represent the only ones whose future is really tragic and which need drastic attention. An examination of reserves shows approximately 14,000,000,000 bbl. of oil to be produced. Our present rate of consumption is about 1,000,000,000 bbl. per year, and by the use of petroleum substitutes which will be of great future help but no immediate aid, we will still be producing from our reserves 65 years from now. However, the price of crude oil will be at least $2.70 per barrel and a shortage will be felt within six years, and an acute shortage will require the use of petroleum substitutes within eight years. A decline of gasoline demand will occur, marked by a change in type of motor vehicles and the more common use of Diesel engines.

Many more oil fields will be found in presently producing states and new areas will become productive such as Iowa, Nebraska, Idaho, Utah and the Dakotas, but the rapid increase in the percentage of the dry holes and the failure to discover new production half as great as our consumption, makes a definite need for careful handling of our dwindling supply.

The first economic pressure will fall on inpendent refineries without owned production and then on the independent producer, because the larger major companies have seen the handwriting on the wall, and twenty integrated companies now own or control 93 percent of our proven reserves and the bulk of all probably future productive acreage.

Stabilization has been the need for the mineral industry for years, but with oil, its period for delay is at an end.

The period of individualistic competition has about expired, and we must now move into an era of industrial and economic coordination. A survey of requirements followed by orderly and controlled development, production and marketing must now obtain.

First must come a change in the fundamental laws for oil and gas which will include laws controlling oil and gas ratios and bottom hole pressures. Laws must be devised which will correct and prevent the evil of offset drilling in areas of flush production, operating under proration. Other laws devised to control wildcatting and the development of pools resulting from that form of exploration are necessary. These laws should probably be state laws so as to better fit the needs of local areas.

Stabilization will then be best served by the development of oil pools as units. If this is not done competitive pools in which the independent producer is operating will soon be exhausted, and much more quickly than similar pools in which the acreage is held by two or three major companies operating under a unit program.

THE EUROPEAN OIL BUSINESS IN 1936.—Oskar Tokayer, in PETROLEUM PRESS SERVICE, vol. 4 (1937), No. 2, pp. 1–2.

It is extremely difficult to trace a uniform line of development in the European oil business. Unlike America, where the freedom from internal customs barriers permits some uniformity of sales conditions in the various states, the continent of Europe is divided up into countries dominated by a multitude of diverse factors, which influence, in different directions, the whole economic structure of the oil business. Any review of the trend of European oil trade in 1936 must therefore be of a somewhat general character and read in the light of the different conditions prevailing. This trend has been chiefly towards a steady consolidation of oil markets, in spite of all the obstacles adverse to such development.

At first sight it would appear that this improvement was due to the general revival in world trade during last year. Undoubtedly most European countries benefited, to a greater or less degree, by the gradual recovery of international trade from the depression. To a large extent, however, improved conditions were the result of the artificial stimulus given to trade and industry by rearmament plans, measures of unemployment relief and import and currency restrictions. If the general position of the oil trade in European countries has been, on the whole, much better in 1936 than in the preceding year, it is primarily because of the improvement in the international oil market situation resulting from rapidly increasing demand, on the one hand, and a better regulation of world crude oil production, on the other. The improvement in the position is better appreciated if one recalls the situation, not so long past, when American over production, Russian dumping and expansion of Roumanian exports combined with a period of economic depression and low consumption to deal a staggering blow to oil markets.

The evidence of this continued progress in the balance of supply and demand is to be found, during 1936, in a more stable price structure and better cooperation between marketing companies. Experience has brought home to the oil industry that cut-throat competition in prices merely results in a loss to everybody concerned and that successful operation is only possible under conditions which admit of due regard to the factors that govern prices on the world market. An additional cause of the stabilization of markets lies in the continued rationalization of methods of distribution, which has made possible further reductions in costs and in certain cases compensated to some extent for prices which would otherwise have been wholly unremunerative.

THE WORLD'S ROADS.—Anon., in OEL UND KOHLE, vol. 12 (1936), No. 34, p. 743.

Road construction is of importance to the petroleum industry from a double point of view. On the one hand a good road system has a direct influence on the development of

traffic, and consequently on consumption of motor fuel and lubricants; on the other hand road construction absorbs large quantities of asphalt and tar. It is, therefore, of interest to note the extension of road construction during the years 1928–29, as shown in the subjoined statistics.

Table I.—Road Mileage (exclusive of towns)
(in km.)

	1928	1934
United States	4,853,196	4,931,994
Russia (including Asiatic port)	1,249,730	2,706,531
Japan	925,698	956,753
France	651,690	653,399
Germany	348,625	348,628
England	288,164	285,351
Poland	224,666	226,837
Italy	186,080	170,248
Roumania	106,080	128,416
Czechoslovakia	72,006	69,459
Hungary	61,469	54,169
Denmark	51,859	51,828
Austria	34,194	37,602
Belgium	27,096	30,468
Holland	24,994	25,495
Switzerland	14,997	15,752

Table II.—Country Roads by Continents
(in km.)

	1928	1934
America	5,997,375	6,260,502
Europe (including Asiatic Russia)	3,942,756	5,449,472
Asia	1,631,549	1,667,856
Africa	423,038	631,354
Australia (New Zealand, etc.)	564,539	842,903

Table III.—Km. of Road to Sq. Km. of Surface Area

Japan	0.3	Czechoslovakia	1.9
Denmark	0.8	Austria	2.3
France	0.8	Roumania	2.3
England	0.8	Switzerland	2.7
Belgium	1.0	Russia (total)	7.9
Germany	1.3	World Average	10.6
Holland	1.4	Europe (total)	4.8
United States	1.6	America (total)	6.4
Italy	1.8	Asia (except Russia)	14.6
Poland	1.8	Australia (etc.)	9.7
Hungary	1.8	Africa (total)	44.25

In comparison with most of the rest of the world the United States is well provided with country highways, but still proportionally only half as well as Denmark, France and England. If doubling road mileage should mean doubling the number of cars, when the United States has as many roads as the three countries named, this country should eventually have more than 50,000,000 cars. However, the exact effect of extension of road mileage on automobile registration is not yet subject to calculation.

General

Problems of Respiratory Protection in the Petroleum Industry and Suggestions for Their Solution.—G. M. Kintz and H. C. Fowler, in Bureau of Mines Information Circular I. C. 6915 (1936).

Proper respiratory protection of workmen, regardless of the industry or the individual occupation, is fundamental for their health, safety, and efficiency. The problems involved in providing this protection have virtually the same elements, although it is unlikely that two jobs, even on the same type of work, will have exactly the same hazards. Satisfactory solution of problems created by atmospheric conditions that are unsafe or detrimental to the health and efficiency of workers can be reached only after careful analysis of individual circumstances. The specific impurity in the air to which each worker on each job is exposed must be determined, its dangers recognized, and effective protective measures taken—measures that not only protect but offer a minimum of inconvenience to the worker.

The literature pertaining to protection against toxic gases in the petroleum industry is extensive, but writings dealing with dusts and other extraneous air-borne material peculiar to that industry are relatively few. Accordingly, this paper deals mainly with hazards of the latter type and makes some suggestions as to protection against them.

Some idea of the importance of the problem of respiratory protection and the tremendous cost incident to this type of hazard may be gained from the fact that lawsuits in the courts of the United States at present involve claims of more than $100,000,000 for silicosis, and Sappington estimates that these claims increased nearly 200 percent over those in the previous year. Although some of these claims will not be allowed and other cases will be thrown out of court, litigation is expensive, and judgments of the order of $14,000 and $21,000 are not uncommon. Hundreds of cases are being settled for smaller amounts.

Some of the more common occupations in the petroleum industries where respiratory protection may be needed are cleaning tanks, gaging, sand-blasting, handling coke, cleaning coke out of stills, cleaning brick, handling dusty materials (such as fullers' earth, cement, lime, gypsum, clays, and dry caustics), certain welding operations, burning lead, burning off paint, paint-spray work, brush painting in close quarters, and the many operations in which workmen are exposed to dust and hydrogen sulphide gas.

The circular gives much information regarding protective appliances and their practical use.

Voltolization Process for Production of Premium Motor Oils.—George M. Woods, in PETROL. ENG., vol. 7 (1936), No. 13, pp. 158–159.

The voltolization process is a method used for producing premium motor oils by subjecting mineral and fatty oils to the action of a high-tension silent electrical discharge. This process has been in commercial operation in Europe for many years and during the past five years has become very widely practiced abroad, due to the expiration of the original patents.

The process is carried out by subjecting the oil to be treated to the action of a high-tension silent electrical discharge of relatively high frequency, the oil being maintained under reduced pressure during this operation. The theory of the voltolization process appears to be the dehydrogenation of the treated oil by means of the electrical discharge, and subsequent polymerization of the olefin material formed.

Oils of extremely high viscosity index and oiliness are produced by the voltolization process. The viscosity index increase is much greater than is possible with solvent treating, and at the same time the oiliness properties of the oil are remarkably improved.

Paraffin wax, petrolatum, or oil may be polymerized by the silent electrical discharge to form oils of high viscosity index. The viscosity and yield of the voltolized oil both vary directly with the intensity of the electrical treatment. Depending upon the intensity of the treatment, two types of oil may be prepared. Mild voltolization produces oils of viscosities of 115 to 240 seconds at 210 deg. F. and yields of from 15 to 40 percent of 120 viscosity index from the charge to the process. Longer and more intense voltolization produces highly viscous oils of 500 to 2,500 seconds viscosity at 210 deg. F. and yields of 50 to 75 percent of approximately 380 viscosity index blending value. These latter highly voltolized oils also have the remarkable property of lowering the pour point of oils to which they are added in small quantities. Thus it may be seen that the voltolization process produces a highly viscous lubricant.

The author set up an experimental apparatus and applied the process to a blend of 50 percent crude scale wax and 50 percent waxy Mid-Continent overhead oil. The result in one case was a motor oil with a viscosity index of 123 and a pour point of 15 deg. F., the estimated cost was 38 cents a gallon. In another case a viscous blending agent was prepared from the same materials. This product, which is estimated to cost 45 cents a gallon, has some remarkable properties; when added to a finished Mid-Continent paraffin base motor oil in the proportion of 90 parts motor oil to 10 parts voltolized oil, the viscosity index of the motor oil was raised from 90 to 119. When five percent of voltolized oil was added to a 30 deg. F. pour point paraffin-base motor oil the pour point was reduced to −15 deg. F.

The success of Paraflow, a pour-depressant, and Exenol, a viscosity index improver (products of Standard Oil Development Co.) has shown the commercial possibilities of such compounds, and warrant the study of the voltolization process as a possible industrial method to be used in the United States.

Corrosion of Tubing in the Oil Industry.—N. W. Mitchell, in OIL AND GAS JOUR., vol. 35 (1936), No. 24, pp. 42–47.

It is estimated that there are 37,500 shell and tube units now in operation in the oil industry, including condensers, reboilers, coolers and heat exchangers of all kinds, from which it is figured that about 16,000,000 lbs. of condenser tubes are now in service in the industry. Estimating the average life of a tube at two years, the oil industry is under the necessity of buying 8,000,000 lbs. of tubing annually at a cost of $1,000,000.

From a survey of 63 units where tubing had corroded, it appears that there are two distinctly different corrosive conditions with which condenser and heat exchanger tubes are in contact. The first is corrosive water, the second is corrosive sulphurous or acidic oil vapors. A metal or alloy resisting one condition fairly satisfactorily may not resist the other.

The author, speaking as a research engineer for a brass and copper company, thinks that the answer will be found in duplex tubes, one within the other. One of these tubes will resist corrosion by water and will consist of an alloy with a high copper content, the other will have a lower copper content and be resistant to sulphur compounds. As a specific example, the author has developed a tube consisting of commercial bronze (90 percent copper, 10 percent zinc) on one side and admirality brass alloy on the other, and service tests of these duplex tubes are now under way.

Improvements Required in Drilling Equipment

(Continued from page 66)

present time are simple in comparison to those which must be drilled within the very near future in order that the deeper oil deposits may be brought into usefulness.

Any and every oil field has a proper number of wells that should be drilled to recover the maximum quantity of oil. Generally, though not always, the greater the number of wells drilled in a given field the greater will be the ultimate yield. But, the number of wells is definitely limited to those that may justify their drilling by a profit increase in the production recovered. This again is dependent upon the cost of the wells, for obviously the lower the cost of the well, the greater the number that may be drilled for the maximum sum that should be expended in the development of any field, within profitable and economic limits.

Unfortunately, for the present and future consumers of the fruits of the industry, the manufacturers of oil field equipment are neither drillers for nor producers of oil nor are those who engage in these two lines of endeavor manufacturers of the equipment, which they use. Except in a few minor instances, they do not even require that their machinery be built according to specifications furnished by themselves. It is not intended to suggest that each drilling organization should have special equipment built for it with the result that manufacturers would have countless designs for a given machine, but it is meant that until the users of equipment give sufficient thought and study to the matter and require of the manufacturers changes to more efficient and better machinery and equipment, no fundamental improvements may be expected. The manufacturers, not being users of their tools, do not know the fine points of the requirements of drilling machinery and though they are presented with them, they are generally averse to making the necessary radical changes, first, because of the immediate cost and upset to the general manufacturing routine and profits and, second, because of the unfortunate fact that most operators are averse to change from the methods that have been in use since the beginning of the industry, in consequence of which the manufacturers cannot move their new machinery in the necessary volume for successful production. Radical improvements in the machinery for and methods of drilling oil wells must begin with those who direct the drilling of the wells, whether they be trained or practical engineers. Also the actual drilling personnel must be trained in and required to use the methods proved by experience to be the best suited for a given operation.

A more liberal and progressive attitude on the part of both the manufacturer of drilling equipment, and the operator is essential to meet the requirements of the ordinary economy expected of all other industries which depend upon natural resources of the nation for their raw material.

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Institute of Metals Council Meeting

THE Council of the Institute of Metals at its last meeting added two names to the short list of Fellows of the Institute—those who " . . . limited in number to 12, shall be members of the Institute who have, in the opinion of the Council, rendered eminent service to the Institute." The names of the persons thus honored by the Council are Dr. Harold Moore, C.B.E., and Mr. W. Murray Morrison. Dr. Moore is a past-president of the Institute of Metals and director of the British Non-Ferrous Metals Research Association. He was elected a member of the Institute in 1920 and has served on the Council since 1924, being a vice-president from 1932–34 and president during the following two years.

Mr. W. Murray Morrison is an Original Member of the Institute, having assisted in its formation in 1908. He is vice-chairman and managing director of the British Aluminium Company Limited, with which company he has been connected for over forty years. He served on the Council from 1912 to 1928, acting as vice-president in the two final years of his Council membership.

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Gulf Export Prices for Major Oil Products

Products		Cents per Gallon			
		Dec. 23	Dec. 30	Jan. 6	Jan. 13
Gasoline:	U. S. Motor	5⅛	5⅛	5¼	5¼
	64/66–375 E.P.	5⅝	5⅝	5¾	5¾
	59 Octane & below	5⅜	5⅜	5⅜	5⅜
	65 Octane & above	5⅞	5⅞	5⅞	5⅞
Aviation Gasoline: (Tank-car F.O.B. Ref.)	73 Octane & above	10	10	10	10
Kerosene:	44 w.w.	4½	5	5¼	5¼
	41–43 w.w.	4⅜	4¾	5¼	5¼
	41—43 p.w.	4⅛	4⅝	5	5
Gas Oil:	26–30 translucent	3½	3½	3¾	3¾
	30 plus translucent	3⅝	3⅝	4	4
Fuel Oil:	Grade C Bunker (per bbl.)	.95	.95	.95	.95
	Cargo lots (per bbl.)	.95	.95	.95	.95
	Diesel oil (per bbl.)	$1.50	$1.50	$1.50	$1.50
Lubricating Oil: (New York Export Market)	Bright Stock No. 8	27½	27½	27½	28
	Bright Stock No. 6½	27	27	27	27½
	600 Warren E.	22½	22½	22½	23
	600 Unfiltered s.r.	20	20	20	20½
	650 Unfiltered s.r.	21½	21½	21½	22
	600 Flash s.r.	22½	22½	22½	23
	630 Flash s.r.	24	24	24	24
	Neutral 200 No. 3	29½	29½	29½	30
	Neutral 150 No. 3½	27	27	27	26½
So. Texas:	Red oil 500 No. 5–6	7¼	7¼	7¼	7¼
	750	8¾	8¾	8¾	8¾
	1200	8¾	8¾	8¾	8¾
	Pale oil 500	7½	7½	7½	7½
	750	8¾	8¾	8¾	8¾
	1200	9	9	9	9
Crude Oil:	East Texas crude delivered at Gulf port for export (per bbl.)	$1.32	$1.32	$1.37½	$1.37½
	Venezuela crude (per bbl.)	1.00	1.00	1.00	1.00
	Trinidad crude (per bbl.)	.90	.90	.90	.90
	Panuco crude (per bbl.)	1.07	1.07	1.07	1.07

Freight Rates

	Dec. 23		Dec. 30		Jan. 6		Jan. 13	
	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean
(Shillings per ton)								
Calif.—U. K. or Continent	20/–	21/–	20/–	21/–	20/–	21/–	20/–	21/–
Gulf—U. K. or Continent	13/9	15/6	13/9	15/6	13/9	14/6	14/6	17/–
Aruba—U. K. or Continent	11/6	11/6	11/6	11/6	11/6	12/–	12/–	12/6
(Cents per barrel)								
Calif—North Atlantic	85	90	85	90	85	90	85	90
Gulf—North Atlantic	36	40	36	40	36	40	40	45
Venezuela—North Atlantic	21	—	21	—	21	—	18	—
Tampico—North Atlantic	29	—	29	—	29	—	20	—

Faced with expiring leases, Mel E. Baish, President of the Maljamar Oil and Gas Company, accompanied by M. W. McNutt, geologist, sought to stake a location. His car stuck, Baish sighted an old Prairie Schooner wheel. Baish settled the question by saying, "Here we will drill Baish No. 1." It became the discovery well of Lea County, New Mexico, and led to such great developments as the Hobbs, Jal and Eunice fields.

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Official Figures for Soviet Oil Operations

1936	Crude Production (bbl.)	Daily Average (bbl.)	Runs to Stills (bbl.)	Drilling (feet)
January	16,155,300	521,139	13,933,000	509,950
February	15,288,700	526,955	13,055,700	516,140
March	16,344,300	527,236	14,259,700	610,306
April	15,589,000	519,633	13,418,300	619,420
May	16,454,200	530,781	14,356,300	621,911
June	15,955,100	531,837	14,365,400	510,860
July	16,231,600	523,600	14,692,300	535,644
August	15,737,500	507,662	14,699,300	571,088
September	14,936,600	497,887	13,926,500	639,553
October	16,118,900	519,970	14,953,000	707,348
November	16,700,000	536,667	14,800,000	550,000
December	16,400,000	529,033	14,800,000	560,000
Total 1936	191,911,200	507,960	171,269,500	6,952,222
Total 1935	176,688,100	497,713	146,705,100	4,868,465
Quota 1936	213,500,000	584,931	175,000,000	7,100,000
Quota 1935	212,310,000	581,672	171,500,000	5,214,000
Quota 1937	241,500,000	661,644	191,500,000	8,200,000

Crude conversion: seven bbl. = one ton

FROM the preliminary figures for Soviet oil operation it is to be noticed that crude production in 1936 exceeds the corresponding figure for the previous year by about nine percent and although the total is below plan, it has approached the 2,000,000 mark as forecast by WORLD PETROLEUM early in the year. The larger portion of Soviet crude in 1936 has been lifted from Baku oil fields which have lived up to plans and have produced a total of 143,508,600 bbl. of crude.

Production by Major Fields, 1934–1936

(bbl.)

	1934	1935	1936	Percent of 1936 total
Baku	133,000,000	136,432,000	143,508,600	74.3
Grozni	24,500,000	23,313,500	22,975,800	12.1
Maikop	6,500,000	8,335,500	7,725,500	4.2
Bashkiria	150,000	2,841,000	6,940,500	9.4
Emba	1,575,000	1,708,000	3,162,600	
Sakhalin	1,580,000	1,652,000	2,217,600	
All others	2,473,700	2,404,900	5,380,600	
Total	168,648,700	176,688,100	191,911,200	100.0

During December Baku oil fields operated on the average at about 96 percent with showings of 98 percent at the beginning of the month and 93 percent at the end of the month. The individual oil field groups of Baku show the following plan operation: (First figure shows operation at beginning and second figure at end of the month): Stalin, 110–102 percent; Lenin, 108 percent; Asisbekov, 105–100 percent; Ordzonikidze, 87–83 percent; Kaganovitch, 91–80 percent; Molotov, 76–69 percent; and Kergez, 100–86 percent. All other Soviet oil fields show the following plan fulfillment for December: Grozni, 82–77; Maikop, 70–60; Emba, 88–80; Kalininfield, 109–70; Voroshilov, 80–50; Bashkirneft, 90–80; Sakhalin, 100–80; and Turcomania, 80–30 percent.

Of all Soviet oil fields outside the Caucasus, Ishimbayevo (now called Bashneft) is gaining considerable importance. This field was opened for commercial production some three years ago under the management of S. Ganshin, former head of Glavneft, and production has increased from 150,000 bbl. in 1934 to about 7,000,000 bbl. in 1936. At Ishimbayevo a small topping plant has been erected, but the bulk of Ishimbayevo crude is now carried by rail to Ufa where a refinery (Alco) has been erected. The first section of the Ufa refinery was completed several weeks ago and put on stream. The atm.-vacuum installation has been tested for operation at or for the capacity of 3,500,000 bbl. of Ishimbayevo crude per year. The Ufa refinery is designed for refining a full line of products including high octane gasoline. The yield of light products from the crude potential will amount to 40–42 percent, which is the highest rate for any Soviet refinery. Thus far the installation has been completed for processing distillates of gasoline, ligroin and lubeoil, down to road oil and the reforming division for high octane gasoline is now nearing completion. It is expected that additional gasoline will be obtained by cracking the broad lubeoil fraction, the residue of which will be used as boiler fuel. Part of the asphalt will be treated for a high melting grade and the gasoline distillate from this fraction will be acid treated and rerun.

Early in 1937 the Ufa refinery will be enlarged and expanded to a total capacity of 7,000,000 bbl. of crude per annum and will thus form the largest combined refining unit among Soviet refineries, simultaneously refining, cracking, reforming and stabilizing with a considerable saving of service and power consumption. The refinery will utilize all gases for fuel and it is expected that part of the gases will be transported for use to the motor plant and the city of Ufa. The refinery at Ufa will be connected by pipeline with the Ishimbayevo oil field. This pipeline is now under construction and is expected to be completed shortly. This line will be the most northerly pipeline in the Soviet Union. It traverses Bashkiria steppe and over 25 kilometers of deep valleys; it is embedded on the bottom of 11 rivers, of which the Belaya river is navigable, and has a width of about 850 ft. The line also traverses tracks of five different railways.

The line has a capacity of 21,000 bbl. of crude per day and the distance between Ishimbayevo and Ufa is 165.8 kilometers.

In regard to Ishimbayevo ZA INDUSTRIALIZATIU of December 29, 1936 has published a report from its correspondent, which we quote here in abbreviated form:

"The operators of Ishimbayevo deny categorically any tendency toward a gusher psychology in operation. They emphasize that Ishimbayevo is a new oil field and is not at all committed to conservatism as are the old Soviet oil fields. Gusher tendencies are not known to all at Ishimbayevo. Very well then, but the actual facts of operation at Ishimbayevo, unfortunately, show a different picture. Of the total 950,000 tons of crude produced at Ishimbayevo during 1936, almost 92 percent was derived from gusher production and only about 8 per cent by mechanized operation, while many wells which were completed for mechanized production are temporarily shut for lack of electrical power.

"During the entire year all efforts in drilling were directed toward production and little emphasis placed on further prospecting, but apart from this even in production-drilling no attempts have been made toward American methods of field operation—particularly in regard to wells at which drilling was completed. At such wells all that is required is installation of some sort of engine—either steam or internal combustion—with deep pumping, and hundreds of tons of crude would have been added to the daily average. However, it looks as if all the shortcomings and technical misgivings of which S. Ganshin spoke so derogatorily at the oil conferences in August, 1936, have found a fertile ground at Bashkirneft and irresponsibility as well as negligence in fulfilling one's daily duty at Ishimbayevo has become a common occurrence.

"During December some 58 or 60 wells were operated out of a total of 82 wells ready for operation, but 42 wells were shut temporarily and 6 wells were being made ready for operation, which brings the total of idle wells to 48, and these could not come under operation owing to lack of electrical power. Lack of electricity at Ishimbayevo is not a temporary shortcoming. It will take some time before the electrical power plant will be completed for operation and the question remains as to why these wells could not and should not be adjusted for operation on steam or gas motors. Ishimbayevo and its operators prefer to await the completion of the electrical power plant

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Soviet tanker Peredovik (Foremost) launched in 1936 being towed to the pier: capacity, 2,500 tons.

and keep the wells completed for operation idle.

"During the cold season the gas lift lines became frozen and operation was brought to a standstill. Why had nobody given previous thought to heating up the lines in time? Can this be qualified otherwise than as negligence? Of course, nobody is going to deny some of the merits of Bashneft. Production has been doubled since 1935 but much more could have been achieved if the operators would have tried to be more efficient and more expedient." At the beginning of 1937 Grozni Oil trust was reorganized into an organization Grozni Oil Combinate, whereby the producing properties and refineries were subdivided similar to Baku, as follows:

Properties: (1) Molgabek fields headed by Gutin, Dagneft. (2) Izberbash, Achisu and Daghestan fields headed by Dirchenko. (3) October oil fields and old Grozni headed by Bezdrobni. Other organizations of the Grozni oil combinate are: Grozneftzavodi (Refineries), Grozneftstroi (Planning and building), Grozneftsnab (Supplies), Grozneftrazvedka (Prospecting), and Research Institutes. Grozneft oil combinate is headed by Rosenoer.

Among the other achievements of 1936 it is to be noted that drilling plan at Baku and Grozni was completed ahead of time. At Baku two more oil regions were added for commerical operation, namely Shongar and Kiziltepe. Three more regions, Pirsagat, Miadjik and Mirsaani, are nearing completion for commercial production. At Miadjik well No. 6 has been drilled 8,540 ft. which is one of the deepest wells of Azerbaidzan. Drilling for all Soviet oil fields during 1936 has made large progress in the distance drilled as well as in speed of drilling, and the total distance drilled during the year shows an increase of about 40 percent over 1935.

The speed of drilling, which was in 1935 about 765 ft. per table per month, has increased in 1936 even above the planned speed of 1,170 ft. to 1,800 ft. in October, and jumped even to 2,700 ft., leaving all plans of the Second Piatiletka far behind.

Considerable progress is also to be noted in runs to stills. The increase over last year is about 20 percent, which is due to the number of refineries erected during the year which have augmented the total capacities and refining facilities. Considerable increases were reported in efforts to expand operations in the form of extended cycles of refinery operation, as well as increased yield of light products per meter of heating surface of the furnaces. Almost all Soviet refineries have fulfilled the plan for the year in form of refinery yield of light products, such as gasoline, ligroin, kerosene, as well as lubeoil distillates. As this was completed five days ahead of time it was expected to have an excess of some 450,000 tons of light products over and above the plan for the year.

The Soviet oil fields outside the Caucasus are slowly but gradually gaining ground and the ratio in percent of production of these fields to the total Soviet production shows an upward trend from year to year. Among the Soviet oil fields outside the Caucasus, Ishimbayevo is coming to the fore and this field, together with Emba and several other regions, form the Soviet Eastern oil base to which much publicity has been given in the Soviet press during recent years. Bashkiria and Emba are the decisive factors in the development of oil in the Soviet East and as of today Emba is the source of crude supply for the refinery at Orsk, while Ishimbayevo crude is carried to Ufa, the refinery which is undergoing expansion and enlargement.

Between these two oil regions Emba operations proceed very slowly and production has been stabilized at the rate of 250,000–300,000 tons per year, while Ishimbayevo has developed more rapidly and crude production in 1936 was doubled against the year 1935 to about 1,000,000 tons.

The idea of developing an oil base in the Soviet East originated in the mind of Lenin, who in 1920 advocated a railroad between Alexandrof-Gay and Emba with a view to connecting these steppe and desert lands with the industrial centers of the country. Lenin also suggested the construction of a pipeline from the operating oil fields of Emba to the Volga, but because of more important and pressing matters of State these projects were shelved for the time being and, therefore, the Soviet Eastern oil fields remained little developed. The properties of Emba have remained far behind Maikop or even the Sakhalin fields in production.

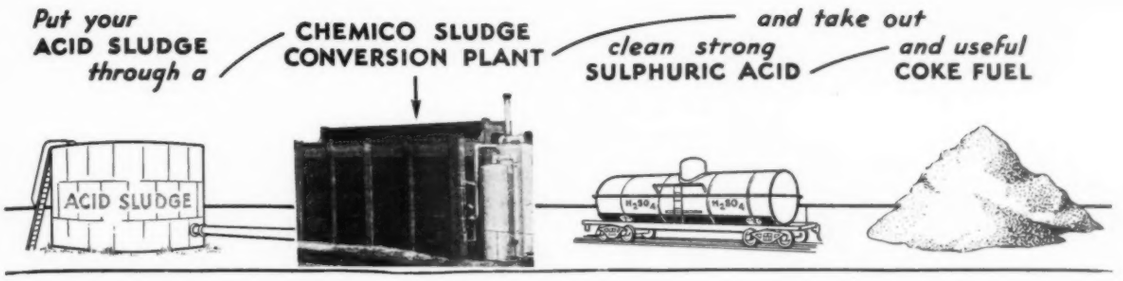
Recent industrialization of the Ural Kuznetzk region, which is growing into a formidable industrial center around which large deposits of coal, minerals and non-ferrous metals have been discovered together with vast resources of timber, have been hampered in development owing to lack of liquid fuel. For these regions the Caucasian source of oil supply is at disadvantage from the point of geographical location and hence the recent attention to the old idea of establishing an oil base in the Soviet East.

Geological research and prospecting has been carried on in the Ural Emba region, in the central part of the region which is enclosed between the two rivers Ural and Emba and consists of two separate oil fields (Temir-Guryeff and Aktiubinsk). The latter field has been recently segregated from Emba oil fields into a separate oil field under Aktiubinskneft. However, the greater Ural Emba consists of much larger oil territory which is evidenced from the discovery of such oil fields as Koschagil, Iskin, Baichunas, Shubar Kuduk, etc., all of which are of post-revolutionary research efforts.

But from a general point the Emba territories have not been studied as yet and it is not unlikely that in geological regard this region may prove not inferior to Baku in oil deposits. The oil formations at Emba are of a salt dome nature. Emba structures resemble the domes of South Texas and Louisiana. The number of studied salt domes of Emba does not exceed 300 but the Aktubinsk region may number about 1,200 more domes, or about one dome to 400–450 kilometers of land area.

In addition Ural Emba is only part of the territory of oil lands between the southern borders of the Turcoman republic, which extend over Kara Kum and Ust Urt, Ural Emba, Transwolga up to Ishimbayevo and the Prikamsk deposits, and further up to the Northern Arctic.

Of all these future oil fields Ishimbayevo is most accessible and also less hit by climatic conditions or by nature's elements. But according to opinions of Soviet key men of the oil industry the successes of Ishimbayevo are far from satisfactory and far from the objective possibilities. Innumerable wells are being kept idle for lack of electrical power, and prospecting operations are hampered by lack of efficiency; also too little attention is being given to mechanized production at wells of below-medium production. Here, as in other Soviet fields, gusher production is the main reliance; no wonder the production curve



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Izberbas of Daghestan, the recent addition to Grozni, is nearing completion. This field consists of about 300 hectares of land and may be extended to a larger area submerged in the Caspian sea. The tectonic is not even, but more favorable than elsewhere at Grozni. The plan for 1937 provides for 7,000,000 bbl. of crude production in this field. However, judging from reports of drilling the plan will be not easy to fulfill.

J. WEGRIN

Soviet Oil Exports

Jan.–Nov., 1936

(tons)

	11 months 1936	11 months 1935
Crude	154,487	107,634
Gasoline	376,981	573,809
Kerosene	359,308	367,270
Lubeoil	220,731	257,457
Gas oil	492,797	453,166
Diesel oil	47,677	86,133
Fuel oil	761,817	1,028,242
Others	10,802	21,776
Total	2,424,600	2,895,487
Value	Rbl. 140,725,000	bbl. 161,399,000

By Countries

France	364,331	355,043
Germany	281,969	423,362
England	240,804	260,815
Sweden	111,527	131,294
Belgium-Luxemburg	99,495	113,813
Spain	90,415	172,458
Italy	88,863	199,381
Denmark	74,806	85,300
All others	1,072,390	1,154,021
Total	2,424,600	2,895,487

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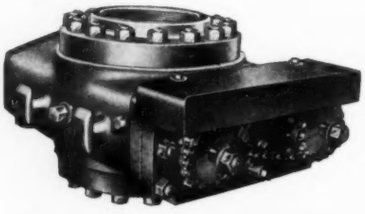

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